MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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EDWARD JAMES STONE, M.A., F.R.S., Vice-President, in the Chair.

Louis Joyner, Bermuda;
Belgrave Ninnis, M.D., R.N., F.R.G.S., 46 Kensington Park Road, W.;
John Krom Rees, A.M., E.M., Director of the Observatory and Professor of Practical Astronomy and Geodesy, Columbia College, New York City, U.S.A.;
William James Watson, Morley House, South Stockton-on-Tees;

were balloted for and duly elected Fellows of the Society.

The following candidates were proposed as Fellows of the Society, the names of the proposers from personal knowledge being appended:—

The Rev. James Baikie, Wood Inch, Dalguise, near Dunkeld, Scotland (proposed by W. S. Franks);
John Dansken, 4 Eldon Terrace, Partick, Glasgow (proposed by R. Grant);
Henry Daniel McCarthy, Cheltenham (proposed by J. McCarthy);
Martin Charles Sharp, M.A., 5 Portman Street, Portman Square, W. (proposed by T. H. E. C. Espin).

Sixty-one presents were announced as having been received since the last meeting, including, amongst others,

Observatoire de Nice: portfolio of engravings and plans, presented by M. Bischoffsheim.

Astronomical Telegrams.

At the Council Meeting on 1892 April 8, attention was called to the suggestion recently made, that the Society should become an English centre for the distribution of astronomical telegrams. It did not appear desirable to consider any course of action independent of the already existing "Centralstelle für Astronomische Telegramme" at Kiel, and a letter from Prof. Krueger (printed below) was laid before the Council. It appeared that there would be some advantages in a scheme whereby the telegrams of the Centralstelle should be sent direct to the Society's rooms, and each then distributed by Mr. Wesley (or his deputy, when away) to such Fellows (or others) as became subscribers. But it seemed necessary that a preliminary inquiry should be made as to the number of possible or probable subscribers; and the Secretaries were accordingly instructed to draw up the present note, requesting those willing to subscribe to send their names to the Secretaries without delay, in order that the Council might then judge of the desirability of the scheme. The following is Prof. Krueger's letter, received in reply to an inquiry by the Secretaries:

"Dear Sir,—I have been away for a few days, and am thus only able to answer your letter of March 28 to-day.

"There is no reason why the R.A.S. should not receive the telegrams of the Centralstelle for redistribution. But it must be made a condition that those persons or observatories who receive our telegrams through the R.A.S. take their share in the total expenses of the Centralstelle. This arrangement is already in existence with the Russian observatories. I only send telegrams (as regards Russia) to Pulkowa, and Pulkowa telegraphs on to all Russian observatories. At the end of the year it is calculated how much is spent on telegrams to Pulkowa; this is divided among the Russian subscribers, and, in addition, it is calculated how much each subscriber must pay towards the general expenses of the Institution.

"If the R.A.S. will undertake the part of an English centre, the subscription for the R.A.S. for the first year would be 3*l.*, and 1*l.* for each subscriber who receives the telegrams. I assume that the Planet telegrams are not wanted, since no one in England has yet cared to follow these objects. If these were included, the subscription for the R.A.S. for the first year would be about 4*l.* For the next year the estimated subscription for the R.A.S. would be about 2*l.*, and at most 1*l.* for the subscribers, again without minor Planets; otherwise 3*l.* to 4*l.* for the R.A.S.

"The more subscribers the cheaper will be the expenses of the Institution. An accurate calculation is made for each subscriber at the year's end, and an estimate made for the following

year. The actual expenses have hitherto always been smaller than the estimated, and the excess is, of course, always credited in the next year. Under such an arrangement the R.A.S. must collect from the subscribers the cost of telegrams sent in England. I enclose forms for our telegrams; these could, if you wish, be translated into English. They have as yet been found suitable for the purpose, and would not be changed except for urgent occasions.

"It is much to be wished that the matter may soon be arranged; up to now Greenwich and Edinburgh are the only English subscribers, while a large part of the Continent, the United States, South America, Cape Town, Madras, and Melbourne are associates. If we could get a dozen observatories from England as new subscribers, the general expenses of the Institution would be reduced, and the success of the undertaking greatly enhanced.

"Should, however, the R.A.S. not care to undertake to be sub-centre for England, it is at least to be wished that English astronomers should be advised to join the Centralstelle in as large a number as possible. The annual cost is small, especially if no minor planets are wanted. I hope you will soon be able to send me news of the development of the scheme.

"Yours, &c.,

"To H. H. Turner, Esq. "A. Krueger.

"P.S.—If the R.A.S. takes over the distribution for England, it would be the simplest course to tell me how many subscribers you would have, and I would then estimate:—

"1. Cost of telegrams to the R.A.S.

"2. General expenses for R.A.S., and the individual subscribers.

"The R.A.S. could pay the whole to the Centralstelle and collect the shares from each subscriber, so that we should only deal with the R.A.S.

"Recently I have thought of another way of dealing:—That the R.A.S. should pay an annual fixed sum to the Centralstelle, and make its own arrangements with subscribers. But I cannot decide on this point, which must be reserved for the decision of the Committee."

If ten subscribers be found, the following would seem to be the advantages of this scheme compared with a direct subscription by each of the ten to the Centralstelle:—

1. The cost would be somewhat reduced, but not very materially. The reduction would be approximately the difference between the price of foreign telegrams and those of English, but not quite, for there is in each case one additional foreign telegram (to the R.A.S.) the cost of which must be shared by the ten subscribers. The contribution of each subscriber for the office

expenses of the Centralstelle would be much the same as if he subscribed directly to the Centralstelle (if expenses incurred by the R.A.S. be distributed among the ten subscribers). But the reduction of the telegraphic expenses may be best shown by an example.

On an average twelve telegrams are sent from Kiel per annum with reference to the discovery of minor planets, and a like number with reference to the discovery of comets and other objects of interest; the average number of words in each telegram, exclusive of the address, being about fourteen. It is possible, as Prof. Krueger points out, to subscribe to the Centralstelle for all telegrams, or to have a partial subscription, in which case discoveries of minor planets are not notified. Supposing, then, that twelve telegrams, each of eighteen words (including address), were received during the year, the cost to a direct subscriber to the Centralstelle would be $216 \times 2d. = 1l. 16s.$; but to a subscriber through the R.A.S., if ten subscribers joined, it would be one-tenth of this (or $3s. 8d.$) plus the cost of English telegrams $= 9s.$, or $12s. 8d.$ in all—a reduction of $1l. 3s. 4d.$

2. The few German words used could be translated into English. But the telegrams are mainly in cipher.

3. English discoveries, communicated directly to the R. A. S., could be circulated immediately without passing through the Centralstelle.

The disadvantages would appear to be

1. The slight delay in re-distribution with possibility of accident to the main telegram.

2. The extra work and responsibility thrown on the paid Secretary of the Society (or his deputy). In view of these considerations, the Council will be guided in their decision to a great extent by the number of possible subscribers; and it is hoped that those interested will communicate with the Secretaries as soon as possible.

Note on the Lunar Theory. By Ernest W. Brown, M.A.

In determining the coefficients of the inequalities in the Moon's motion, which depend on the eccentricity and the ratio of the mean motions of the Sun and Moon, it is important to have the motion of the perigee of the Moon accurately determined. I have completed the determination of those coefficients which are of the form $e^f(m)$, and in particular that part of the evection which is of the above form. The determination of the part of the motion of the Perigee required for this involves the solution of an infinite determinant. In vol. viii. of the *Acta Mathematica* Dr. Hill has, however, found a value for this

quantity calculated to fifteen places of decimals. This value I have succeeded in verifying as far as nine places of decimals, by proceeding in an entirely different manner. His value is

$$\frac{1}{n} \cdot \frac{dw}{dt} = 0{\cdot}008572573004864.$$

Using this, the following coefficients in longitude were obtained for those parts which are of the form $e f(m)$:—

$$\begin{aligned}
&+4607''{\cdot}9836 \sin(2D-l) + 35''{\cdot}2200 \sin(4D-l)\\
&+0''{\cdot}2906 \sin(6D-l) + 0''{\cdot}0028 \sin(8D-l)\\
&+174''{\cdot}8610 \sin(2D+l) + 1''4460 \sin(4D+l)\\
&+0''{\cdot}0121 \sin(6D+l) + 0''{\cdot}0001 \sin(8D+l)
\end{aligned}$$

These values are all correct to the last decimal given. The notation is the same as in Delaunay's Lunar Theory, and his value of the eccentricity, for purposes of comparison, has been used. The results, however, are adapted for any value of the eccentricity with the given one for the mean motions. It may be stated that Delaunay's value for the corresponding part of the evection in longitude is

$$4607''{\cdot}7710.$$

I hope before long to publish the complete determination of all the inequalities depending on the eccentricity and mean motions, including that part of the motion of the perigee which depends on the eccentricity of the Moon. This will amount to a general solution in series of Dr. Hill's equations.*

$$\frac{d^2x}{dt^2} - 2n'\frac{dy}{dt} + \left(\frac{\mu}{r^3} - 3n'^2\right)x = 0$$

$$\frac{d^2y}{dt^2} + 2n'\frac{dx}{dt} + \frac{\mu y}{r^3} = 0$$

In this solution the eccentricity of the Moon is left arbitrary.

Haverford College:
1892 *March* 28.

* *Amer. Journ. Math.*, vol. i. p. 129.

Observations of the Spots and Markings on the Planet Jupiter, made at the Dearborn Observatory, Northwestern University, Evanston, U.S.A. By G. W. Hough, Director.

The observations for longitude, latitude, and magnitude of objects on the planet *Jupiter* have all been made with the parallel wire micrometer, preferably near the central meridian, but no rigid rule is followed in this respect. The longitude and latitude are usually determined whenever the spot or marking is wholly on the disc and distinctly visible.

The longitudes are ascertained by measuring the distance of the apparent centre of the object from the two limbs of the planet, according to the method I pointed out some years ago. A determination of longitude or latitude generally consists of three bisections of the object and each limb of the planet. In the case of longitude, one-half of the difference of the distances at the mean of the times is the distance of the apparent centre of the object from the central meridian of the visible disc. This method of determining longitudes has been found to be greatly superior, in point of accuracy, to the method of transits, as well as a great saving of time.

Professor Barnard, of the Lick Observatory, in the publications of the Astronomical Society of the Pacific, No. 5, and in the *Monthly Notices of the Royal Astronomical Society*, 1891 November, on insufficient data, has too hastily assumed that the method of eye estimates, or transits, may be as accurate as micrometer work.

My observations on the planet *Jupiter* with the 18½-inch refractor of the Dearborn Observatory have been continuous since 1879, with the exception of the opposition of 1888 and a portion of 1889, during which period the telescope was dismounted for removal to the new site at Northwestern University.

The great red spot, owing to its long period of visibility, is perhaps the most interesting object on the disc. Since its observation in 1878, *Jupiter* has made a complete revolution in his orbit, and the red spot appears to have preserved its outline, shape, and size with very little change during the whole period.

There has been marked fluctuation, however, in its colour and visibility, the spot at times being so faint as to be invisible with small telescopes.

During the past twelve years a number of observers have asserted at different times that the red spot was connected with, or merged into, a belt in its immediate vicinity. This matter was fully discussed some years ago, and I inferred from what was then said that it was the general opinion of all astronomers who used sufficient optical power, that the spot was at all times separate, although in close proximity to other matter.

During 1889 and 1890 the planet was too far in south declination to afford any definite information. So far as my

observations go, however, the spot has always been distinct and separate from surrounding matter, apparently exerting a repelling force, as I stated in my Annual Report for 1883.

During the past opposition, under favourable conditions the spot was noted as pale pink, being similar in tint to what it was in 1879–80, but the colour was not so intense. The spot this year was not so strongly defined as the equatorial belt.

In the comparison of observations for latitude, made in different years, it is more convenient to use the distance from the equator expressed in seconds of arc, reduced to mean distance.

If the Jovicentric or Jovigraphic latitude of a spot is given, one does not know where to look for it on the disc unless the latitude is reconverted into seconds of arc.

I have, therefore, added the reduced latitude, obtained by applying the correction for the elevation of the Earth above *Jupiter's* equator. This correction is given in degrees in Marth's invaluable Ephemerides, published annually in the *Monthly Notices* of the Royal Astronomical Society.

In computing the correction to be applied to the apparent latitude, I have used the values $18''{\cdot}33$ and $19''{\cdot}48$ for the semi-axes of the planet at mean distance.

These values for the size of the disc were found from a great many differential measures made in 1880–81, and are somewhat larger than those given by heliometer measures, owing to irradiation, but they will probably better satisfy micrometer work.

In the determination of rotation period, the observations have been corrected for longitude of equinox, aberration time, annual parallax, and defective illumination. With the exception of the longitude of equinox, all the other corrections have been taken from Marth's Ephemerides.

The time used is that of the 90th meridian west from Greenwich.

The Great Red Spot.

The following rotation periods will indicate the motion of the great red spot since last year :—

1890 July 1 to 1890 Dec. 8, (160 days),

$$R = 9^h\ 55^m\ 39^s{\cdot}75$$

1890 July 1 to 1891 May 25, (328 days) $39^s{\cdot}96$ secs.

1890 Dec. 8 to 1891 May 25, (168 ,,) $40^s{\cdot}10$,,

1891 May 25 to 1892 Jan. 22, (242 ,,) $41^s{\cdot}27$,,

These numbers indicate that the spot has not yet ceased to retrograde.

During the past opposition the "mean" period $41^s{\cdot}27$ does not satisfy the observations, but a uniformly retarded velocity represents the motion fairly well. I have given in col. 4 the residuals (Observation—Ephemeris) for a uniform rotation $41^s{\cdot}27$, and in col. 5 the same for a retarded motion, $R = 9^h\ 55^m\ 40^s{\cdot}0$

$+n \times 0^s{\cdot}005$, in which n equals the number of rotations from the epoch 1891 May 25.

For a uniform rotation period the "mean" residual (Obs.—Eph.) is $\pm 1^m{\cdot}7$, and for a retarded rotation $\pm 1^m{\cdot}2$.

T = Time of passage over the central meridian.

L = Length of chord on middle of disc.

B = Breadth.

β = Apparent latitude.

The length of the great red spot appears to be about 1″ shorter than in former years. In 1890 the length from two measures was 11″·49. In 1889 the spot was too indistinct for reliable measures of length.

The Great Red Spot.

Date 1891	Days	T	$41^s{\cdot}27$ Obs.-Eph.	$40^s + n \times 0^s{\cdot}005$ Obs.-Eph.	L	B	β
		h m	m	m	″	″	″
May 25	0	14 29·7	+2·7	+1·0	...	...	...
July 5	41	13 20·8	+1·0	+0·9	...	...	−7·21
9	45	16 38·4	+2·1	+2·1	10·24	4·09	6·63
14	50	...	...	...	...	3·83	7·00
20	56	10 38·9	−3·8	−3·4	10·36	4·69	6·84
22	58	12 19·2	−1·7	−0·7	11·18	...	...
26	62	15 32·9	−4·3	−3·7	...	...	7·09
Sept. 6	104	10 13·0	−0·1	−0·1	...	...	...
9	107	7 39·8	−2·2	−1·3	...	...	6·35
11	109	9 20·1	+0·2	+1·2	...	...	7 19
16	114	8 22·1	−5·0	−3·9	...	...	7·49
21	119	7 34·5	−0·1	+0·8	...	...	7·30
3	121	9 12·4	−0·3	+0·4	9·85	4·95	...
25	123	10 51·6	+0·7	+1·4	10·48	4·50	6·82
Oct. 5	133	9 07·4	+0·9	+1·8	...	...	7·27
7	135	10 44·9	+0·1	+0·9	...	...	7·30
22	150	8 08·8	−0·8	−0·3	...	...	7·08
27	155	7 18·7	+0·5	+0·8	...	...	6·56
Nov. 17	176	9 42·4	+1·1	+0·9	...	...	6·68
30	189	5 34·4	+2·9	+0·5	...	...	6·54
Dec. 29	218	4 41·3	+2·6	+0·5	...	...	7·13
1892 Jan. 22	242	4 41·6	+3·5	+0·0	...	...	...

Mean Length ... 10″·42 (5 obs.)

„ Breadth ... 4·41 (5 obs.)

Reduced Latitude −6·52 (17 obs.)

Dark Spots on B_6.

During the opposition of 1891, three separate spots were observed on this belt, two of which were distinctly red in colour and of considerable length. The third spot appeared as a dusky hazy patch, and was $0''.7$ farther south.

The rotation periods for these objects were $9^h\ 55^m\ 20^s$ and $9^h\ 55^m\ 0^s.3$.

Long. Red. B_6.

$R = 9^h\ 55^m\ 20^s$.

Date. 1891.	Days.	T h m	Obs.-Eph. m	L ″	B ″	β ″
July 3	0	16 41·7	−2·4	...	...	−8·23
8	5	15 48·8	+1·0	7·26	...	9·02
15	12	16 30·7	+3·0	7·67	1·05	9·59
28	25	11 59·6	−1·7	...	...	9·20
Sept. 7	66	10 10·5	−1·2	7·91	1·03	8·54
15	74	6 45·1	+3·8	...	...	8·66
22	81	7 22·3	+1·4	...	...	8·80
24	83	8 57·0	−0·3	...	...	...
29	88	7 56·8	−4·1	7·49	1·31	8·63
Oct. 9	98	6 12·0	+3·6	...	...	...
16	105	6 48·0	−1·1	...	...	...
28	117	6 32·7	−2·0	...	...	...

Length ... ... $7''.58$ (4)
Breadth ... ... 1·13 (3)
Reduced Latitude −8·34 (8)

Long. Red. B_6.

$R = 9^h\ 55^m\ 03^s$.

Date. 1891.	Days.	T h m	Obs.-Eph. m	L ″	β ″
Nov. 5	0	7 05·6	+0·0	11·00	...
26	21	8 58·2	+3·3	12·23	−8·64
18	43	6 35·9	+0·1	...	...

Length ... ... $11''.61$ (2)
Reduced Latitude −8·24 (1)

Dusky Black Patch. B_6.

$R = 9^h\ 55^m\ 20^s$.

Date. 1891.	Days.	T h m	Obs.-Eph. m		β ″
Sept. 10	0	9 33·7	+0·0	...	−9·41
Oct. 9	29	8 05·3	+1·4	...	...
14	34	7 06·2	−1·6	...	9·37
16	36	8 45·9	+1·3	...	9·47
21	41	7 47·2	−1·6	...	9·46
Nov. 2	53	7 36·8	+2·2	...	...
Dec. 18	99	5 09·0	+0·1	...	...

Reduced Latitude $-9''{\cdot}01$ (4)

Dark Spots on the North Edge of the Equatorial Belt.

During the opposition of 1890, from June 12 to October 20, five small reddish black spots were observed on the north edge of the equatorial belt; two of these spots have been observed again in 1891.

The rotation periods for the several spots observed in 1890 were as follows :—

	h m s	days
a =	9 55 34·0	130
b =	33·3	179
c = „	„ 36·6	70
d = „	„ 32·0	108
e =	36·6	7

The spots a and b were observed in 1891. The mean longitude of b with reference to a was as follows :—

	m
1890	+40·2
1891	+24·8

The following are the rotation periods for the spot a :—

1890 June 12 to 1890 Oct. 20	130 days	
$R = 9^h\ 55^m\ 34^s{\cdot}0$		
1890 Oct. 20 to 1891 July 9	262 days	$31^s{\cdot}4$
1891 July 9 to 1891 Nov. 5	119 „	$27^s{\cdot}4$

These numbers indicate a pretty uniform decrease in the rotation period.

Spots a and b, North Edge of Equatorial Belt.

$R = 9^h\ 55^m\ 27^s.4$

Date. 1891.		Days	T h m	$b\Delta t$ m	Obs.-Eph. m	β ″
July	9	0	14 01·1	...	+0·0	...
Sept.	8	61	8 43·3	22·6	+1·7	+4·36
	10	63	10 17·3	23·8	−3·0	...
	15	68	9 23·8	25·0	+0·9	...
	25	78	7 37·4	25·7	+5·1	4·17
	29	82	10 45·3	27·8	−1·1	...
Oct.	2	85	8 13·8	25·8	−0·4	...
	9	92	8 54·5	26·2	−2·1	3·87
Nov.	2	116	8 33·6	21·9	−0·4	...
	5	119	6 01·8	...	+0·7	...

Mean difference of Longitude *a* and *b*, $24^m.8$

Reduced Latitude + 4″·67 (3)

Small Black Spots on B_2.

A number of small black spots were seen in reduced latitude + 9″·34, but accurate longitudes were not determined. In 1880, from August to October, two small black spots were observed in latitude +11″·0. The rotation periods were $9^h\ 55^m\ 31^s.0$ and $40^s.5$ respectively. See Report of the Dearborn Observatory, 1881.

Small Black Spots on B_3.

During the past opposition a great number of small black spots were seen on the south margin of this belt, appearing like a row of beads, making it difficult to identify individual spots. The longitudes of three of these spots, the first of a row, were accurately determined on two successive nights, and when compared with Marth's Meridian II. they indicated a gain of $7^m.5$ daily, or a rotation about 3^m less than the great red spot.

The following are the times of transit :—

	h m	h m	h m
Sept. 7	11 14·1 (*a*)	11 30·7 (*b*)	12 03·1 (*c*)
Sept. 8	6 56·5 (*a*)	7 14·6 (*b*)	7 47·8 (*c*)

Additional spots :—

	h m	h m	h m
Sept. 8	8 06	8 23	8 36
„	8 57	9 27	9 52

Latitude observed :—

Sept. 7	+6″·11	Sept. 25	+6″·34	Oct. 9	+5″·64
Nov. 24	+6·15	Dec. 11	+6·06		

Reduced Latitude +6″·56 (5 obs.)

I observed spots on this belt in 1880–84.

Elliptical White Spots on B_6.

During every opposition since 1880 elliptical white spots have been observed on a belt just south of the great red spot. These spots usually have a drift in the direction of the planet's rotation when referred to the great red spot.

The spots whose longitudes were determined in 1891 had a direct motion of about $0^m{\cdot}9$ daily.

The following transits have been observed :—

Date. 1891.	T h m	β ″	
Sept. 25	9 47·5	−9·10	Group of spots.
25	10 01	...	
25	10 16 (*c*)	...	
25	11 02·3	...	
Oct. 22	9 01·4 (*a*)	−9·12	
27	8 01·7 (*a*)	−9·25	
29	7 53·4 (*c*)	...	
Dec. 29	4 24·0 (*a*)	...	

Reduced Latitude −8″·71 (3)

On the south margin of B_6, in reduced latitude −10″·7, elliptical white spots have been observed at every opposition since 1880. These spots are the most difficult of any of the markings visible on the planet, and can only be seen under favourable atmospheric conditions. The rotation period deduced from them is approximately the same as for the great red spot. In 1883, however, they had a retrograde drift of 1·2 degrees daily, or a rotation period 50 seconds greater than the great red spot.

Equatorial White Spots.

The equatorial belt was usually mottled with white spots on both the northern and southern portion, but none of the spots were particularly conspicuous.

Date 1891	Days	T h m	Obs.-Eph. m	β ″	Remarks.
July 8	...	15 34·3	...	−2·32	Double Spot
9	...	14 50·9	...	+2·19	Double Spot
15	...	16 18·5	...	−3·30	
15	...	16 04·0	...	+2 (est.)	
Sept. 10	0	9 43·5	+ 0·0	+2·20 (*a*)	
10	...	9 57·9	+ 0·0	−3·32 (*b*)	Spot foll. 8ᵐ·6, 0″·5 south
29	...	8 22·0	...	+2·01	
Oct. 16	...	9 00·0	...	−3 (est.)	
Nov. 2	53	7 30·9	+12·0	+1·48 (*a*)	
2	...	7 30·9	+ 9·0	−3·00 (*b*)	
18	69	7 11·0	− 0·9	+1·95 (*a*)	
18	...	7 11·0	− 0·9	−1·43 (*b*)	
Dec. 18	99	5 35·1	− 7·7	−2·20 (*b*)	

The approximate rotation periods are

	h	m	s			
a =	9	50	31·6,	69 days,	Reduced latitude	+2″·67 (3)
b =	9	50	26·4,	99 „	„ „	−2·00 (4)

The motion was not uniform.

The Equatorial Belt.

During the past two years the great equatorial belt has been quite open. At times, however, a faint marking has extended over the middle portion. The approximate width of the open part in 1890 was 2″·6, and in 1891 3″·1, or about one-third of the total width of the belt.

During the past thirteen years the belt has usually been separated in two portions by a rift, but at times, notably in 1879 and 1880, the belt was made up of three nearly equal portions, the central one being midway between the other two.

In the observations which follow, the 2nd col. is the approximate longitude in time, from Marth's Meridian II.; 3rd col., position angle of the north edge of the belt; 4th col., comparison with Marth's ephemeris for *Jupiter's* equator; 5th col., apparent latitude of the north edge; 6th col., width of the belt.

The comparison with the ephemeris indicates that the north edge of the belt was parallel to *Jupiter's* equator.

The Equatorial Belt.

Date. 1891.	Long. h	P °	Obs.-Eph. °	β ″	W ″
July 3	+3·3	64·1	−0·7	+3·76	9·31
8	+4·3	63·6	−1·2	3·60	8·80
9	−1·5	...	...	4·19	...
14	+0·0	64·4	−0·4	...	...
15	+3·7	65·1	+0·3	3·21	9·11
20	+0·6	67·1	+2·2	3·40	9·98
23	−3·5	63·6	−1·3	3·74	...
26	+0·0	65·6	+0·7	...	...
Sept. 8	−3·7	65·2	−0·1	4·36	7·93
21	+0·5	64·2	−1·3	...	...
25	−2·3	65·5	−0·0	4·17	7·16
29	−5·8	65·8	+0·2	...	9·30
Oct. 7	−0·3	66·4	+0·7	3·67	7·88
9	+1·5	...	...	3·87	...
20	+1·6	65·3	−0·5	3·78	9·51
Nov. 2	−4·0	65·9	+0·1	...	...
24	−2·0	...	...	3·49	7·67
26	−3·8	67·1	+1·4	...	8·22
Dec. 11	−1·5	65·7	+0·2	3·13	7·96
18	−4·5	64·3	−1·1	...	...
29	+0·5	64·8	−0·5	...	...

Inclination of the North Edge of Equatorial Belt to Equator = −0°·07

Reduced Latitude +4″·25 (13 obs.)
„ „ +4·79 (13 obs.) 1890
Mean Width 8·57 (12 obs.)
„ „ 10·42 (9 obs.) 1890

Theory of Jupiter.

In my annual Report of the Dearborn Observatory, 1881, I gave the following hypothesis—viz.: "That the surface of the planet is covered with a liquid semi-incandescent mass, that the belts, the great red spot, etc., are matter at a lower temperature. Over the liquid surface is an atmosphere, in which is formed the equatorial white spots, which are of the nature of clouds."

I still think that the lower surface of the planet is of the nature of a liquid, but not necessarily hot.

Observations of the Reappearance of the Rings of Saturn; Observations of the Position-Angles of the Rings, and Observations of the Satellites. By E. E. Barnard.

The conditions for observation at the reappearance of the rings of *Saturn* in 1891 were somewhat better than those at the disappearance in 1878. Neither the reappearance of 1878 nor the disappearance of 1891 could be observed on account of the proximity of the planet to the Sun.

At the present reappearance of the rings, the planet was situated in the morning sky, two hours and a half west of the Sun, and in three and a half degrees north declination.

From Professor Hall's valuable memoir on *Saturn* (being Appendix II. of *Washington Observations for* 1885) we learn that with the 26-inch the rings were wholly invisible at the disappearance of 1878, except where they were projected on the ball of the planet. Since the reappearance of *Saturn* from the region of the morning Sun, I have examined it carefully a number of times with the 12-inch, and on two occasions, when the opportunity permitted, with the 36-inch.

Up to October 29, on no occasion, with the most careful scrutiny and good seeing, was it possible to detect the slightest trace of the rings projected on the sky, though they appeared as a heavy black band crossing the planet and apparently cutting it nearly in halves.

On October 22 *Saturn* was carefully examined with the 36-inch, but the rings were equally invisible in that instrument. The observations extended from $17^h\ 15^m$ to $18^h\ 15^m$ Standard Pacific time (8^h slow of Greenwich). The seeing was 3 on a scale of 5 for perfect steadiness. The projection of the ring on the ball was perfectly black. The edges were sharp and perfectly free from irregularities, and no evidence of the crape ring was seen. The southern edge of the trace was slightly convex. Only one belt was visible, and that was some $3''$ south of the ring.

I very carefully measured the width of the projection of the ring at its middle part on the ball. This could be done with great accuracy by placing the wires so that their outer edges exactly filled the black trace, the measures being corrected for the thickness of the wires ($0''{\cdot}12$). The resulting value, at $18^h\ 0^m$, gave the width of the middle of the projection $= 0''{\cdot}51$. This agrees exactly with the value derived from the data in the American Ephemeris ($0''{\cdot}51$).

The measured distances of the centre of the projection from the polar limbs of *Saturn* were

From north limb $= 7''{\cdot}40$

From south limb $= 6{\cdot}56$

At the observations on this date the earth was 1°36′ north of the plane of the rings, and the Sun 0°8′ south.

October 26, I examined the planet carefully with the 12-inch. The seeing was nearly perfect (from 4 to 5). With magnifying powers of 150–175–500 there was no trace of the ring against the sky. I was struck at this observation, however, with a phenomenon that may be very important in dealing with observations of the ring at and near disappearance. Looking at the black trace on the ball, and then glancing at the sky near the sides of the planet, I could, apparently, see the rings for a moment as a faint line of light on the dark sky. I satisfied myself beyond question that this was an optical phenomenon.

Perhaps everyone is familiar with the "after image" produced by looking, say, at the sash of a window when projected on a bright sky from a more or less darkened room. After gazing at the window for a few moments and then turning the eyes to a dark part of the room, a perfect image of the window sash appears, the lines being white, however, instead of black as in the window.

This phenomenon was easily produced by looking at the black line across the bright disc of *Saturn*, and then glancing at the dark sky where the ring ought to appear. I mention this, as it might some time mislead an observer, who would think he had glimpsed the real ring. Perhaps this same phenomenon has a bearing on other kinds of astronomical observations.

October 27 and 28 were cloudy.

On October 29 the planet was observed with both the 12- and 36-inch refractors. At $17^h\ 0^m$ Mt. Hamilton mean time, with the great telescope, the rings were easily and distinctly visible as slender threads of light. It was not possible, however, to see them at their junction with the ball, they being invisible for a space of about 2″ through nearness to the bright disc of *Saturn*. Perhaps this was also due to the fact that the ansæ would be brighter at a distance equal to the inner edge of the bright rings.

Continuing the lines of light, they would have joined the planet slightly north of the north edge of the trace of the rings on the ball, as I have shown in the drawing for October 29.

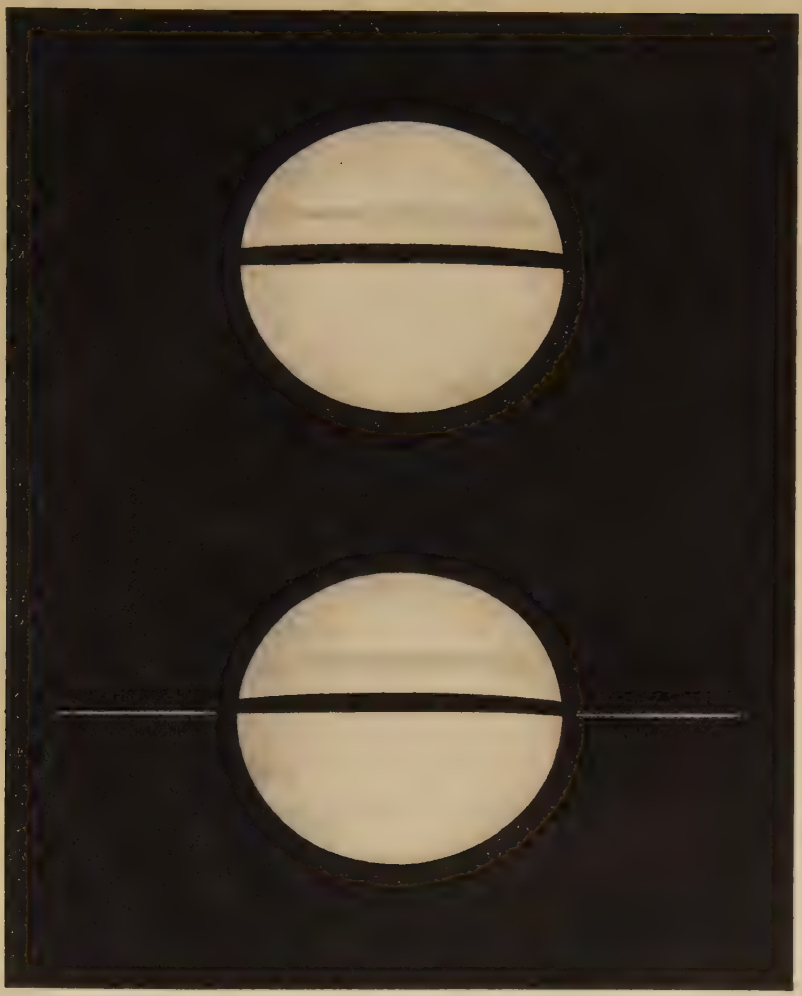
On this date I again measured the projection of the rings on the ball.

$$\text{Middle width} = 0''{\cdot}65$$

According to the American Ephemeris, this value at that time was 0″·63.

At $17^h\ 30^m$ I examined the planet with the 12-inch. The rings, though faint, were distinctly visible, but much less conspicuous than in the large telescope.

At the observation of this date the earth was 1°58′ north of the plane of the rings, while the Sun was exactly in their plane, according to the Ephemeris.



Saturn 1891 October 22 and 29
36 inch Refractor, Lick Observatory.

Diagram Oct. 29 1891 Saturn
Showing the positions of the two irregularities on the Ring.
$17^h 30^m$

The following notes were made, among others, during these observations:—

October 29.—The following ansa appears the brighter. There are two little lumps on the south edge; possibly two satellites. Rings not seen up to ball. They would touch the planet, if continued, *north* of their trace on *Saturn*.

November 3.—The preceding ansa is the brighter, and appears uneven. Rings cannot be seen up to ball; continued, they would pass *north* of their trace on the planet. The rings are very pale and their light weak, compared with the ball. Trace very black.

November 5.—Possibly the following end is the brighter.

November 6.—Possibly the following end is the brighter.

In all the observations the projection of the ring on the ball was perfectly black, and no trace of the division could be seen.

In the drawing of October 29 I have not attempted to show the two inequalities on the following ansa. They were quite difficult, and any attempt to show them on the drawing would be an exaggeration. I therefore append a small diagram, given on the plate, which will show their position. I assume they were two of the inner satellites.

No spots, dark or light, have been seen on the ball of *Saturn* at any time during the observations.

The observations with the two telescopes during October confirm the extreme thinness that has been attributed to the rings. Under more favourable circumstances of observation it is possible that they may be visible in the 36-inch, but at the disappearance of the past year they were certainly beyond reach of both instruments.

It is probable that the rings are less than 50 miles in thickness.

In *Monthly Notices* for January, 1892, Professor Oudemans gives an account of his observations of the reappearance of the rings of *Saturn* with the 9½-inch equatoreal of the Utrecht Observatory.

Professor Oudemans says that on October $29^{d}\ 17^{h}\ 30^{m}$ (= October $29^{d}\ 9^{h}\ 3^{m}$ Mt. Hamilton M. T.) *Saturn* was decidedly without any ring. October 30 was cloudy, but on October 31, at $17^{h}\ 30^{m}$, a momentary view showed the ring at both sides of the planet as a thin bright line.

Combining my observations of October 29 with those of Professor Oudemans for the same date, it is evident that the time of reappearance of the ring is narrowed down to the interval between $9^{h}\ 3^{m}$ and $17^{h}\ 0^{m}$, October 29^{d}, 1891, Mt. Hamilton M. T. The American Ephemeris gives October 30 as the time of reappearance.

In the *Monthly Notices* for November, 1891, the Rev. Mr. Freeman has given his observations of the reappearance of the ring with a 6-inch refractor.

October 29^d 18^h 10^m to 18^h 35^m G. M. T., he saw nothing of the ring.

October 30^d 18^h 25^m to 18^h 35^m he was also unsuccessful.

But on November 1^d 17^h 30^m G. M. T., he plainly saw it as a fine bluish line of light. From his observations he deduces October 31^d 18^h G. M. T., 1891, as the time of the passage of the plane of the rings through the Sun.

Mr. Freeman's telescope was too small to show the ring early enough, and his data will therefore be insufficient to determine the position of their plane.

Position Angles of the Rings.

In the *Astronomical Journal*, No. 246, I have given a number of measures of the position angles of the rings of *Saturn* with the 12-inch, and a comparison with the American Ephemeris values.

From these observations (on thirty nights) I deduced a correction of $-3''{\cdot}36 \pm 1''{\cdot}68$ to the position angles derived from the Ephemeris. Since the reappearance of the rings I have continued these measures. Following are the observations so far continued:—

Observations of the Position Angles of Saturn's Rings.

1891–92.	Mt. Hamilton M.T.	P.A.	Set.	See.	O−C.
	h m	°			°
Oct. 22	17 30	85·70	4	3	−0·23
29	17 30	86·10	5	...	−0·55
Nov. 3	17 8	85·83	5	5	−0·19
5	17 33	85·46	5	2	+0·13
6	17 0	86·14	4	2–3	−0·54
21	17 27	85·62	5	2	+0·11
27	17 30	85·76	5	4	+0·01
Jan. 10	14 4	86·03	4	4–5	−0·12
Mar. 8	15 57	85·69	5	4–5	0·00
9	8 54	85·75	5	5	−0·07
16	9 26	85·68	5	4–5	−0·05
		Mean deviation	...	...	−0·14

These observations give a correction of

$$-8''{\cdot}40 \pm 1''{\cdot}02$$

to the Ephemeris.

The measures in October and the first part of November were made under unfavourable conditions compared with those printed in the *Astronomical Journal*, and should have less weight.

Conjunction of the Satellites with the Ring.

The following observations of the satellites of *Saturn* have been made. These observations will be continued. Absence from the Observatory during the latter part of January, February, and a part of March has prevented more observations of the satellite so far this year.

Conjunction of Tethys and following end of Ring.

1892.	h	m	s	
Jan. 10	14	9	18	*Tethys* $\frac{1}{3}$ thickness of wire following.
	14	12	43	„ $\frac{1}{4}$ „ „ „
	14	15	53	Conjunction.
	14	19	28	*Tethys* past conjunction by $\frac{1}{4}$ thickness of wire.
	14	22	58	„ „ „ $\frac{1}{2}$ „ „ preceding thickness of wire 0″.44. Mag. power 175 on 12 in.

Conjunction of Rhea and following end of Ring.

Rhea North.

	h	m	s	
Jan. 22	15	28	11	*Rhea* 1 thickness of wire preceding end of Ring.
	15	31	31	„ $\frac{1}{2}$ „ „ „ „
	15	35	31	*Rhea* in conjunction with following end of Ring.
	15	42	21	$\frac{1}{2}$ thickness of wire following end of Ring.
	15	47	21	1 „ „ „ „

In these observations the micrometer wire was made vertical to the ring. The moment of conjunction could be quite closely observed, as any displacement was easily seen by bisecting the satellite or the end of the ring.

Mount Hamilton:
1892 *March* 17.

Note on the Transit of Titan, 1892, *March* 11. By Arthur Mee.

This evening, with pretty fair definition, I had been observing the Moon, and afterwards (about 10.15) turned my $8\frac{1}{2}$ in. Calver equatoreal on *Saturn*. I immediately saw, a little way within the southern limb, and slightly east of the meridian, a dark spot, and almost immediately afterwards a brown spot still further to the east. I watched the pair with powers 200–400 till I had to leave the telescope. The dark spot seemed central at 10.30. Looking up the almanac next day, I found the dark spot was the shadow of *Titan* in transit, and it at once occurred to me that

the brown spot must be the satellite itself, and, as I can find no record of a similar previous observation, I venture to forward this note, hoping that others with ampler opportunities will tell us more of a deeply interesting if not unique phenomenon.

Llanelly:
1892 *March* 11.

Notes on the Spectrum of the Great Sun-Spot Group of 1892 *February.* By Prof. K. D. Naegamvala, M.A.

While examining the large spot group, which made its appearance on the Sun's disc early last month, for the widened lines in the region *b* to F, on the 12th of the month, I found that, besides an unusual thickening of the lines both in intensity and number, the F and C lines were reversed at the centres of the two chief nuclei of the group. The absorption was so intense that the lines were frequently obliterated in the nuclei, and I had to displace the nuclei from the slit and observe the widenings in the neighbouring portions of the spot.

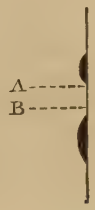
While repeating the observations on the morning of the next day, at about 10.30 Madras mean time (5.10 A.M. G.M.T. nearly), with the slit crossing both the nuclei, it was found that the reversed lines of the day previous had greatly increased in intensity. During observation, the C line gradually extended from one nucleus to another, and was displaced towards the more refrangible side by about its own thickness. The F line was also similarly affected, but with it the displacement was greatest in the space *midway between* the two nuclei. Subsequently, when the slit was placed slightly off the centre of the preceding nucleus (A) with the fine motion in declination, a small *dark* prominence was observed on the F line towards the less refrangible side, a little preceding A, and tipped downwards in the spectroscope towards the spot. On bringing the spot (A) again on the slit it was found that the F line in the spot had assumed a lozenge shape and was also deflected towards the more refrangible side by a distance estimated to be equal to the thickness of the F line. To make myself certain of the existence of the dark prominence, the spectrum was adjusted for the C line, when the black prominence was again observed, but the tip was now deflected away from the spot. That the appearance was not due to any defect or flaw in the instrument was evident from the fact that the appearance was not presented in any other part of the spectrum examined (C to F), except on the two H lines.

Besides the lines C and F, the lines D_1 D_2 D_3 b_1 b_2 b_3 b_4 were found reversed, and on pointing the observing telescope to the region near G it was ascertained to be similarly affected.

The *b* lines, though found reversed, were not observed

bright in the *same* region of either of the two nuclei, and the two centres of the spot had to be slightly shifted in the slit to successively observe the reversals of the four *bs*. The uprushes, therefore, of the elements represented by these lines were evidently of a more restricted character than those of hydrogen and sodium.

D_3 was very bright in both the nuclei, but did not extend from nucleus to nucleus like the hydrogen lines. On the other sides of both the nuclei, however, the helium line extended in continuation of the bright ones, though situated slightly towards the red end. On the side of the preceding nucleus (A) it extended to a distance of about six times the length of the reversed D_3 in the nucleus, and on the side of the nucleus following (B) it was observed to a distance equal to about four times the length of the reversed line in that nucleus. These absorption helium lines were not of uniform thickness and intensity, and they gradually disappeared on the background of the spectrum. The space between A and B was also subsequently found to be crossed by the absorption line of D_3, but there it was much less in intensity than beyond the spot centres. A short while after, the spots were put off the slit by a slight motion in declination, when almost throughout the whole



region of the spot-group the dark D_3 was observed flashing out, rather fuzzy in appearance and broadened as indicated on the less refrangible side, but in regions beyond A and B. At no time did the bright D_3 cross from spot to spot as did the H lines.

Other duties obliged me to postpone observing at about 12.30, Madras mean time, but three hours afterwards (about 10 A.M. G.M.T.), when I resumed observing, the disturbance had almost died away. D_3 was completely absent from both the spots, either as an absorption or emission line, and the only line then positively seen to be reversed was C in nucleus A, while the reversal of F was also suspected. On the other hand, the spectrum of nucleus B was normal in appearance.

On writing to the Director of the Colaba Magnetic Observatory, I was informed that "one of the largest magnetic storms of recent years occurred here (at Bombay) between 10 A.M. (local time ?) of the 13th, and 10 A.M. of the 14th inst. It

continued in moderated intensity for the next twelve hours, and then gradually died away."

The spectroscope employed had a dispersion of three flint prisms of 60° once reversed, with collimator and spectroscope of 1″ aperture, magnifying fifteen diameters. The dispersion obtained showed many more lines than in Angström's Spectre Normal.

The Mahârajah Takhtasingjee (of Bhavnagar) Observatory, College of Science, Poona:
1892 *March* 11.

On the Estimation of Star Magnitudes by Extinction with the Wedge.
By Capt. W. de W. Abney, C.B., D.C.L., F.R.S.

Some experiments which I have recently made, and communicated to the Royal Society in a paper by Gen. Festing and myself, Colour Photometry, part III., have a direct bearing on the estimation of star magnitudes by the wedge, and it has seemed advisable to put on record in what way this occurs.

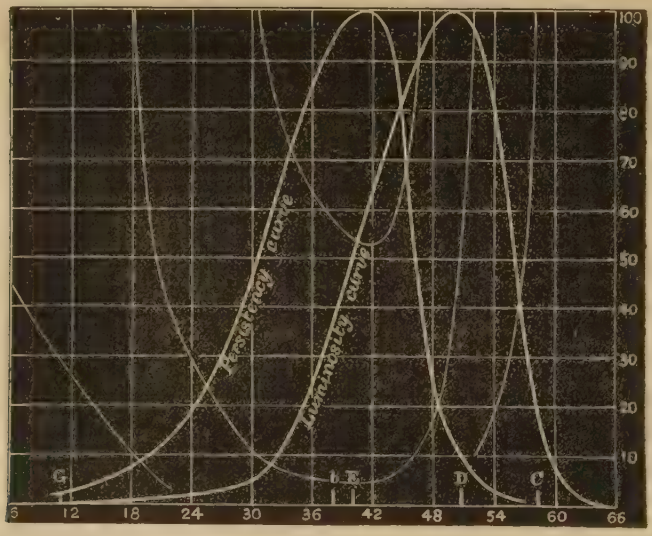
Amongst other matters, the question arose as to the amount by which the intensity of any ray of the spectrum would have to be reduced before it became invisible. Of course the comparative luminosity of the spectrum had to be known at the various parts, and when the absolute luminosity in candle power of any one ray was known, the others could be calculated. In the experiments in question, the spectrum used was that formed by the positive pole of the electric light, and the comparative luminosities were measured, as also the absolute intensity of the light at D coming through a slit placed in the spectrum. This light was spread out into a square patch by a suitable optical arrangement so as to fall on the end of a darkened box, where a black screen with a white disc received it. The light was gradually diminished until the eye which observed through a small aperture in the box could no longer distinguish the white disc. Measures taken in this way showed that if the D light were reduced to $\frac{35^{\circ}}{10,000,000}$ of a standard amyl lamp (which in future for shortness I will call A L) the illumination was so feeble that the white disc could no longer be seen, and no scintilla of light was visible to the eye. The green E light had to be reduced to $\frac{65}{10,000,000}$, the F light to $\frac{150}{10,000,000}$, the G light to $\frac{3,000}{10,000,000}$, whilst the red light at C had only to be reduced to $\frac{110,000}{10,000,000}$ before the screen was invisible. These are the numbers when the D light in the

original spectrum had a luminosity (or brightness) equal to 1 A L, illuminating a screen 1 foot off. If we make the rays of the spectrum throughout equal to 1 A L, these numbers, of course, will be modified. The D light would remain at $\frac{350}{10,000,000}$ A L, since it was originally of the value of 1 A L, but the E light would be $\frac{35}{10,000,000}$ A L, the F light would become $\frac{17}{10,000,000}$ A L, and the G light $\frac{15}{10,000,000}$ A L, while the C light would be $\frac{22,000}{10,000,000}$ A L.

Further, it was found that near F, but on the G side of it, the extinction value of 1 A L became $\frac{15}{10,000,000}$, and remained the same to the extreme violet. It will thus be apparent that to extinguish two lights of equal luminosity, one of C colour and the other of G, the reduction to produce extinction required for the latter is nearly 1,500 times greater than that required for the other. I may remark that a little further than C towards the extreme red, the extinction is the same for every ray when equal luminosities are used.

The Young-Helmholtz theory of colour-vision tells us that there are three fundamental sensations, which are popularly named red, green, and violet, and that at each end of the spectrum but one sensation is excited, viz. at the extreme red, the red sensation, and at the extreme violet, the violet sensation, and that intermediate colours are produced by different degrees of stimulation of the three sensations. The extinction curve of the spectrum offers some confirmation of this theory; for evidently if but one sensation exists at each end of the spectrum when the luminosities of the different rays at these parts are made the same, the extinction of the one sensation will be the same, and would therefore give straight lines in the curve of extinction for equal luminosities, which it does. But we must not forget that the violet sensation is 175 times more persistent than the red, and probably 50 times more than the green. Hence, if we have a colour such as blue-green, which is produced by exciting the violet and green sensations, and probably also slightly the red sensation, when we extinguish this colour it will be the violet sensation which will be far the last to be extinguished. When the green sensation is twenty-five times, and the red sensation 1,500 times more strongly excited than the violet, then all three would be extinguished together. But measures show that if we mix 1,500 parts of pure red with one part of pure violet, the latter is unperceived; and the one part of violet can scarcely have any effect when mixed with twenty-five green. We may take it, therefore, that almost up to the point near D, where the violet sensation ceases,

according to the Young-Helmholtz theory, the sensation that is extinguished is the violet sensation. If, now, we take the reciprocals of the extinction curve of the spectrum, we shall have the amount of violet sensation which exists between the extreme violet and near D. This evidently is the case; for if twice as much violet sensation is excited by one colour as is excited by another, then in order to extinguish the first we must reduce it twice as much as we shall have to reduce the last. This curve of reciprocals we have called the persistency curve. We have thus arrived at the fact that the first sensation to be excited by feeble light is the violet, and that in the electric light spectrum the colour in which it is most present is close to E; in other words, that the maximum of the curve is there. I may mention that in examining two persons who possessed monochromatic vision their measures of luminosity of the spectrum coincided with the persistency curve of my eyes, which, it may be remarked, are normal; and also that the persistency curve of red-blind and green-blind persons are also the same, but that of a violet-blind person is totally different.*



The wedge has therefore so to reduce the light of a star that this violet sensation is not excited; and the last ray which will be extinguished will be the green close to E, supposing the light to be similar in quality to that emitted by the positive pole of the electric arc light.

It must be remembered, however, that we are not dealing

* This being so it is probable that all extinctions made by any one except a violet colour-blind person would be comparable with one another.

with the spectrum when we are extinguishing starlight, but extinguishing all the violet sensation contained in that light.

In a paper in the *Phil. Trans.* on the "Transmission of Solar Light through the Atmosphere," I have shown that the total absorption of light by a medium of varying thickness can be ascertained by measuring the absorption of a single ray which lies close to the maximum of its absorption curve in the spectrum. It follows, therefore, that to scale a wedge for extinguishing of white light, the absorption of E light should be measured. The electric light as used by myself differs very little from sunlight, and any small variation in the quality of the light will not materially shift the position of maximum. The measurement of the absorption of the brightest part of the spectrum, or of the whole of the rays, will not necessarily give the true extinction value of the wedge. If a really black wedge were used, as all rays would be equally reduced, the measurement of the total light transmitted, or that of any ray through different thicknesses of the wedge, would give the coefficient of the wedge for extinction purposes; but if a purplish wedge or an orange wedge were used, it might not do so, supposing that the absorption of E light was different from that of the other rays.

I believe that the wedges used by Professor Pritchard are of a greenish hue, and consequently the place of maximum luminosity of the spectrum seen through it would not differ much from E. I have a wedge myself in which the coefficient of absorption of the total light differs very largely from the coefficient of absorption of the E light. Such a wedge, if graduated in the ordinary way, would give erroneous results.

Another point to be noticed is this, that star magnitudes obtained by extinction should agree better with those obtained by photography than those obtained in the ordinary way by eye estimation. The first would be obtained by an estimation of the E light, the second by that of the light between G and F, and the last by that of the light near D; for it is in these places that the maxima of the curves of extinction, sensitiveness of photographic salt, and luminosity of the spectrum to the eye are respectively situated. A red star would be most frequently of less magnitude to the eye than to the photographic plate, and by extinction it would be between the two. A blue star would be just the reverse, but the extinction magnitude would again probably lie between the two.

Estimations of Magnitude of Nova Aurigæ, made at the Radcliffe Observatory, Oxford. By E. J. Stone, Esq., M.A., F.R.S., Radcliffe Observer.

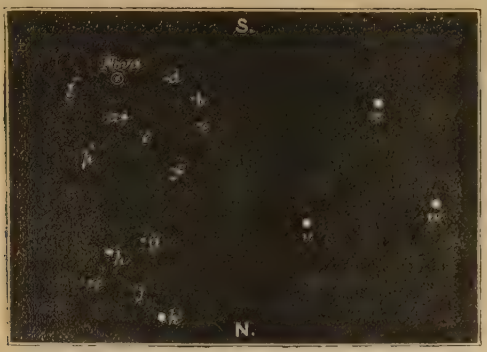
Date.	Observer.	Observed Magnitude of *Nova*.	Comparison stars.	Remarks.
1892.				
Feb. 3	F. B.	4·4	—	Transit-circle observation. No colour to star.
3	E. J. S. and R.	4·5	χ Aurigæ	Observed with Barclay Equatoreal. Star reddish.
5	R.	4·6	...	Transit-circle observation.
13	F. B.	5·1	...	Transit-circle observation.
16	R.	5·7	χ Aurigæ	Naked-eye estimation.
18	F. B.	5·3	...	Transit-circle observation. Star reddish.
22	W.	5·3	...	Straw yellow. Transit-circle observation.
24	R.	6·1	Arg. Z + 30°·898 and 963	Observed with Barclay Equatoreal on February 24, and all succeeding dates.
Mar. 19	E. J. S.	8·8	*v*, *w*, *x*, *k*, *a*, and Arg. 963	
19	F. B.	9·1	*v*, *w*, *x*, *k*, Arg. Z + 30°·938 and 939	Red colour.
22	W.	9·6	*g*, *h*, *i*, *k*	Not very red, but occasionally a deep red flicker seemed to pass over the image.
22	R.	9·6	*a*, *h*	
24	R.	10·4	*a*, *g*, *i*, *k*	
24	W.	10·7	*a*	
25	W.	11·7	*a*, *b*, *c*	Just discernible through haze.
28	F. B.	13·1	*e*, ξ, *d*, *c*, *j*	Sky very clear.
29	R.	13·0	*b*, *c*, *d*, ξ	Very cloudy. Observed in brief intervals of cloud.
30	F. B.	13·7	*e*, *f*, *d*, *p*, ξ	Very brilliant sky. Moon nearly set.
30	W.	14·0	ξ	Probably near the limit of the power of the telescope.
31	W.	14·0	ξ, *d*	Not continuously seen.
31	F. B.	14·0	*p*, *d*, ξ	Sky very clear, but moonlight.

Moonlight has interfered to some extent with any further observations; but, as a matter of fact, although the star has

been looked for on all clear nights up to April 7, it has not been distinctly recognised since March 31.

Observers: E. J. S., Mr. Stone; W., Mr. Wickham; R., Mr. Robinson; F. B., Mr. Bellamy.

The relative positions of many of the comparison stars and *Nova* are roughly indicated in the following chart:—



	h	m	°	′	
Nova = R.A.	5	25	N.P.D. 59	38	(1892·0)
Star *k* = „	5	25	„ 59	28	„

The following are the adopted magnitudes of the comparison stars (in the chart) used in determining the brightness of the *Nova*; they are derived from observation. The magnitude of star *k* is *assumed* to be 9·5 (from *Argelander*), and the limit of vision 14·5.

a = 10·2 mag.	*i* = 10·3 mag.	
b = 11·8 „	*j* = 12·3 „	
c = 12·0 „	*k* = 9·5 „	Arg. Z + 30°, No. 924
d = 13·5 „	*v* = 9·7 „	
e = 13·4 „	*w* = 9·7 „	
f = 13·5 „	*x* = 9·7 „	
g = 10·2 „	*y* = 14·3 „	
h = 9·7 „	*ξ* = 13·9 „	

The magnitudes of the remaining comparison stars are taken from *Argelander*, viz.:—

χ Aurigæ	5·0 mag.
Arg. Z + 30°·898	6·2 „
Arg. Z + 30·963	6·0 „
Arg. Z + 30·938	8·7 „
Arg. Z + 30·939	9·5 „

The magnitudes of the comparison stars, and therefore of the *Nova* referred to them, are at present only provisional.

Radcliffe Observatory, Oxford:
1892 *April* 8.

The New Star in Auriga. By George Knott, B.A., LL.B.

The following observations of the new star in *Auriga* form a continuation of the series in the March number of the *Monthly Notices*. The magnitudes were either gauged directly by the method of limiting apertures, or estimated by comparison with stars the magnitudes of which had been so gauged:—

	m		m
Mar. 12	7·0	Apr. 1	13·4
14	7·7	2	13·5
18	8·9	3	13·5
19	9·1		
25	11·6		
28	12·2		
30	13·0		
31	13·3		

As the star decreased in brightness its colour seemed to deepen slightly to a ruddy orange. On March 18 the F line in the spectrum was still bright and well seen, but I felt doubtful as to other lines. I thought it probable that as the light of the new star faded I should find that I had underestimated the magnitude of the 11 mag. star referred to, with measures, in my former paper. This has proved to be the case. From several determinations I find 10·6 as this star's probable magnitude. The star D.M. +30°·924 I have observed to be 10·5 mag., a magnitude fainter than the D.M. estimate. This star is preceded 10^s, 3′*s*., by a rather brighter star of about 10·3 magnitude.

I give below a list of approximate places for 1892·0 of some small stars in the near neighbourhood of the new star. As most of the stars are faint, the places given are only rough approximations. In the list the new star is marked "var."

Mag.	R.A. h m s	Decl. ° ′
13·3	5 25 0	+30 22·4
var.	25 3	21·8
10·6	25 6	23·0
13·4	25 6	20·1
13·6	25 9	23·1
11·9	25 13	20·0
12·2	25 16	20·1

If the places of the stars in the above list are roughly charted, and compared with the sky, there will, I think, be no difficulty

in their identification. I hope that the magnitudes of the stars will be found to be fairly correct. Unfavourable weather, and the presence of the Moon, have at times made observation difficult.

Knowles Lodge, Cuckfield:
1892 *April* 6.

Anderson's New Star in Auriga. By S. W. Burnham.

My observations of the new star which has recently appeared near 26 *Aurigæ* are confined to micrometrical measures of its position with reference to the faint stars in the field with it. The 36-inch refractor has been used, and I have measured all the stars within a radius of 2′ which could be seen with that aperture. Some moderately bright stars with greater distances have been measured, but without attempting to include all the outlying stars which could be seen.

The following are the measures:—

A and B.

1892·115	81°·6	32″·98	5·7	. . .	14·5	4·30
·118	84·1	33·21		. . .	15·5	6·30
·151	84·7	33·41		. . .	14·5	6·35
1892·14	83·5	33·20			14·8	

A and C.

1892·151	152°·0	49″·54	. . .	15	6·15
·153	153·7	48·57	. . .	15·5	9·10
1892·15	152·8	49·05		15·2	

A and D.

1892·151	170°·8	66″·07	. . .	15	6·10
·153	170·0	66·64	. . .	15	9·15
1892·15	170·4	66·35		15	

A and E.

1892·115	323°·3	74″·44	. . .	11·5	4·35
·118	323·9	74·30	. . .	12	6·35
·151	323·6	74·22	. . .	11·5	6·45
1892·14	323·6	74·24		11·7	

A and F.

1892·112	32°·5	85″·24	10	5·15
·115	32·0	84·70	10·5	4·35
·118	32·4	85·22	11	6·35
·151	32·6	85·04	10	6·35
1892·12	32·4	85·05	10·4	

A and G.

1892·115	138°·5	97″·67	11·4	4·50
·118	138·8	97·54	12	6·35
·151	138·4	97·85	11	6·20
1892·13	138·4	97·69	11·5	

A and H.

1892·115	50°·0	118″·77	11·5	4·40
·118	50·0	118·23	13	6·40
·151	49 8	118·74	11	6·35
1892·13	49·9	118·44	11·8	

A and I.

1892·151	161°·3	154″·76	11·7	6·30
·153	161·0	154·26	12	9·00
1892·15	161·1	154·51	11·8	

A and J.

1892·115	21°·8	159′·98	12·5	4·55
·118	21·9	159·46	13·5	6·40
·151	22·1	158·90	12	7·30
1892·13	21·9	159·45	12·7	

A and K.

1892·170	231°·7	170″·40	13	9·15
·186	231·5	170·87	13	7·40
1892·18	231·6	170·63	13	

A and L.

1892·115	126°·6	172″·21	. . .	10·5	4·55
·118	126·9	171·14	. . .	10·5	6·45
·151	127·0	171·60	. . .	10·8	6·25
1892·13	126·8	171·65		10·6	

A and M.

1892·118	18°·6	183″·95	. . .	6·45
·151	18·6	183·56	. . .	7·35
1892·13	18·6	183·75		

A and N.

1892·112	115°·9	213″·14	. . .	11	7·40
·115	115·7	212·30	. . .	10·5	4·50
·118	115·8	213·05	. . .	10·5	6·45
·151	115·9	212·68	. . .	10·8	6·30
1892·12	115·8	212·79	. . .	10·7	

E and e.

1892·118	24°·0	13″·44	12	. . .	14	6·50
·151	23·7	13·52	11·5	. . .	12·5	6·45
·153	24·8	13·49	11·8	. . .	13	9·15
1892·14	24·2	13·48	11·8		13·2	

M and m.

1892·115	55°·6	3″·22	13	. . .	13·5	5·10
·118	50·7	3·76	14	. . .	14·5	6·50
·151	51·9	4·32	12·5	. . .	12·5	7·40
·153	56·2	4·17	13·5	. . .	13·8	9·20
1892·13	53·6	3·87	13·2		13·8	

There is no star in Argelander in the place of the new star. The nearest star is D.M. (30) 924, given as 9·5 *m*. This is too distant for the field of the lowest micrometer eye-piece of the large instrument, but I have measured these stars with the 12-inch as follows:—

New Star and D.M. (30°) 924.

1892·112	354°·5	455″·61	7·25
·148	354·4	454·68	6·10
·167	354·4	455·05	8·30
·178	354·5	454·83	6·50
1892·15	354·45	455·04	

The three stars which are nearest the primary, B, C, and D, are faint objects, and none too easy to measure with the large telescope. Most of the more distant stars would be easily seen with a much smaller aperture. Two of these, E and L, have very faint companions, and the latter in particular is troublesome to measure. The bright companion, F, is undoubtedly identical with the 9·5 *m* star referred to by Deichmüller (*A.N.*3070) as having been seen by Krueger in 1858, and 2ˢ·5 following, and 0′·8 north of the present place of the new star.

During the measures the new star has appeared at all times down to the present a little fainter than 26 *Aurigæ*, and, therefore not brighter than 5·5 *m*. There has been but little change in the magnitude thus far. It may be mentioned in this connection that on November 28 I discovered with the large telescope the duplicity of 26 *Aurigæ* (distance 0″·15), and measured the new pair and the old distant companions on several nights between that date and January 22 (see *Astr. Journ.*, No. 256).

I have compared the new star in declination with D.M. (30°) 913, which precedes the former about 111ˢ. By three observations the new star is 9″·28 south. In the course of these measures of the various companion stars I noticed that the 8 *m* star, D.M. (30°) 942, which is in the finder following the new star, was a moderately close equal pair, not hitherto known as a double star. This star is *Lalande* 10423. The following measures were made with the 36-inch :—

1892·118	217°·8	0″·83	8·5 . . . 8·5
·151	217·9	0·82	8·5 . . . 8·5
·153	218·0	0·87	8·5 . . . 8·5
1892·13	217·9	0·84	8·5 . . . 8·5

This, of course, would be an easy pair, and will probably have been noticed by other observers.

The accompanying diagram shows the relative positions of the various stars which have been measured from the new star.

Mount Hamilton :
1892 *March* 10.

Stars near the new Star in Auriga,
from measures with the 36 inch telescope.

S.W.Burnham del.

Note.

Since the foregoing was written a very decided change has taken place in the light of this star. My last measure given above was made on March 9, and during the time covered by these observations there had been but little change in the magnitude. The difference from night to night was hardly perceptible, and the diminution did not appear to amount to more than half a magnitude. On March 13 a change was very apparent, and it was then but little, if any, brighter than D.M. (30°) 942, the new double star referred to in the foregoing. Argelander's magnitude of this is 8·0. On the 15th a comparison with D.M. (30°) 913, 924, and 942 gave 8·5 as the magnitude of the new star; on the 16th it was apparently 8·6; on the 20th it was estimated 9·3; and on the 21st, my last examination, it was 9·4. At the present rate of decrease it will soon be comparable with some of the fainter stars I have measured. These stars have a sufficient range of magnitude to be useful for comparison as long as the new star is within the reach of any telescope.

The Double Star, Σ3123. By S. W. Burnham.

There is, perhaps, not another double star in Struve's great work, *Mensuræ Micrometricæ*, which has been measured so rarely as Σ3123. It has been known for more than sixty years, and yet at the most there are but five sets of measures, and two of these are within the last ten years. The scarcity of measures is undoubtedly due to the fact that it is at all times a difficult pair, and beyond the reach of many telescopes used in micrometrical work. There are some observations showing that this star, at various times, was apparently single.

The following are both the positive and the negative results arranged in chronological order:—

1832·20	289°·7	0″·3	W. Struve 3*n*
1840·43	265° ±	obl.	O. Struve 2*n*
1841·41	268°·7	0″·44	O. Struve 1*n*
1841·56	275°·3	0″·3 ±	Madler 1*n*
1842·78	291°·3	0″·2 ±	Madler 1*n*
1851·44	Elong. in 231°?		O. Struve 1*n*
1858·44	Single		O. Struve 1*n*
1861·26	Single		O. Struve 1*n*
1862·39	Single		O. Struve 1*n*
1862·95	Single		Dembowski 1*n*
1868·56	Single		O. Struve 1*n*
1881·32	Round		Bigourdan 1*n*
1881·38	221°·9	0″·32	Burnham 2*n*
1892·14	200°·0	0″·37	Burnham 3*n*

A careful examination of these observations shows that probably this is a case of slow angular motion, with very little change in the distance. The motion is retrograde, and the distance cannot have been at any time much less than 0″·3. An annual motion of about 1°·5 in position-angle will represent the observations as well as could be expected in a pair of this kind. My measures in 1881 were made with the 15½-inch refractor of the Washburn Observatory, with which this pair was well seen. The last measures were made here with the 36-inch. With the larger telescope, of course, such a pair is very easy under any suitable conditions, and the observations should represent the relations of the components very accurately. The two stars are sensibly equal in magnitude, but there is hardly any doubt about the quadrant, because the angular change between 1832 and 1841, and between 1881 and 1892, would seem to show that there could not have been an occultation during the intervening time when it was not seen double, nor any considerable diminution in the distance. Evidently this is not so interesting a binary as heretofore supposed, since the angular motion in sixty years is only about 90°.

The place of this star (1880) is:—

R. A. $12^h\ 0^m\ 0^s$
Decl. $+69°\ 22'$

It is desirable that this pair should be carefully measured every few years.

Mount Hamilton:
March 10.

A New Binary Star, β 581. By S. W. Burnham.

This fine triple star was discovered in 1878 with the 18½-inch refractor of the Dearborn Observatory. As the close pair was 0″·4 in distance, it was readily measurable with that instrument, and with a moderately close third star it was an interesting object on the telescope, visually at least. About the same time it was measured by Dembowski, and a few years later by Engelmann, so that we have good positions for the components at that time. I have recently looked it up, and made a set of measures with the 36-inch refractor of this observatory. Since these last measures were made I have received from Schiaparelli two sets of measures which fill an important place in the intervening period.

The following are all the measures of both components to this time:—

A and B.

1878·15	176°9	0″·40	8·0	. . .	8·0	β 2_n
1878·22	180·3	0·40	8·7	. . .	8·7	Δ 1_n
1883·37	205·2	0·30		. . .		En 5_n
1889·23	249·8	0·4		. . .		Sp 4_n
1890·21	253·7	0·5		. . .		Sp 4_n
1891·97	259·4	0·46	8·5	. . .	8·6	β 4_n

A B and C.

1878·13	185°·3	4″·76		. . .	10·5	β 3_n
1878·22	184·3	4·76		. . .	11·0	Δ 1_n
1891·97	192·7	4·60		. . .	11·5	β 4_n

Some of the angles of the close pair are reversed, but I have placed them all on the same side, since this gives nearly uniform motion during the whole time. As there is no material change in the distance, there can be no doubt that this is the proper disposition of the angles, making the total motion during this time 82° instead of 262°. The components are so nearly equal that the 36-inch shows but little difference in magnitude.

There is a remarkable similarity between this triple system and that of ζ *Cancri*. The close pair of the latter has a period of about 58 years. In this star the motion of AB since 1878 has been at the rate of 6° per year. On the assumption of uniform motion, this would give almost exactly the same periodic time. The third star, C, is about the same distance from AB in each case. In ζ *Cancri* the annual motion is about half a degree in a retrograde direction; while in β 581 the movement is direct, and about the same in amount. Of course, the latter is a much more difficult triple than ζ *Cancri*, and will require a much larger aperture.

This star is Lalande 15743, and the place (1880) is:—

R.A. $7^h\ 57^m\ 44^s$
Decl. $+12°\ 38'$

The triple, β 582, is 22^s following, and 13′ *s*. As a wide pair (20″) this is Σ 1179. On the same night, when the other triple was discovered, I found that the smaller component of Struve's pair was also double. The third star is nearly 4″ from B in the direction of 57°. The distance of the wide pair has increased a little more than 2″ since the measures of Struve in 1829. This is probably due to proper motion. There has been but little, if any, change in the new star since 1878.

Observations of Nebulæ with the 36-inch Refractor of the Lick Observatory. By S. W. Burnham.

The observations of nebulæ which follow were all made with the 36-inch equatoreal, and substantially all of them in the months of September and October, 1891. Most of the objects were selected from the General Catalogue, because of some uncertainty in the descriptions of the nebulæ, or doubt concerning their places or actual existence. These observations were dovetailed in with the regular work, so as not to interfere materially with the more important micrometer measures of close double stars; and, of course, the best nights were not used for this purpose, but the conditions were good enough for work of this character.

I have relied upon Dreyer's General Catalogue for the places and the general descriptions. The numbers used in all cases refer to this work. I have referred the places derived from the measures to 1860, the epoch of the General Catalogue. It would certainly be a great convenience to observers if the places of all newly discovered nebulæ were given in the same way. There is nothing gained by carrying the places forward to any current date. So far as setting on these objects is concerned, one time is as good as another, and since we have a general catalogue there is every reason for adhering to that epoch. For the general purposes of a catalogue approximate places are sufficient, and the nearest minute of R.A. is close enough; but it is very desirable that as many nebulæ as possible should be carefully observed with the micrometer, and measured directly (angle and distance) from some convenient star for the detection of proper motion. It is in this way only that change of this character is likely to be discovered. The R.A. and Decl. may have the highest accuracy, but there is no way of easily ascertaining whether there has been any movement. If we have the angle and distance from a star in the field, the micrometer wires can be placed in a couple of minutes so as to show whether or not it is necessary to do anything more. Of course, for this purpose, it is a matter of no consequence that the comparison star is not found in any catalogue.

In the course of these observations some new nebulæ have been found in the vicinity of the catalogue nebulæ under examination. These are referred to in the proper places. No attempt has been made to find new objects, and in my regular work with micrometer the faint nebulæ which are occasionally met with are, as a rule, only saved when they are near enough to some prominent star for direct measures.

No. 607.

R.A. $1^h\ 27^m\ 16^s$
Decl. $-8°\ 7'{\cdot}8$

This is one of D'Arrest's nebulæ, given in Dreyer with the note, "11 *m* star nebulous ?" and it is further stated, "No nebulosity seen by Schönfeld, but Auwers saw it (*Kön. Beob.* 226)."

This should be, from the catalogue place, a little preceding an $8\frac{1}{2}$ *m* star. There is certainly nothing in this place. I found a rather conspicuous nebula a short distance following, which was subsequently identified as Dreyer 615. This has a bright central nucleus, with long nebulous wisps extending on each side in the direction of 160°—340°. These streaks extend roughly about 33″ on either side of the nucleus. This nebula is 20^s following, and 126″ north of the $8\frac{1}{2}$ *m* star mentioned above. The star is S.D. (8°) 273. Applying these differences to the S.D. place of the star, we have for the place of the nebula (1860):—

R.A. $1^h\ 28^m\ 26^s$
Decl. $-8°\ 3'{\cdot}3$

This agrees substantially with Herschel's place. A few nights later (1891·753) this region was very carefully examined again. There was nothing in the catalogue place of Dreyer 607 in the least suggestive of nebulosity. There is no doubt that No. 615 is the object which has been seen in looking for the other, and that it is one of the many instances of mistaken identity.

No. 618.

R.A. $1^h\ 28^m\ 20^s$
Decl. $+32°\ 40'{\cdot}6$

Dreyer has the note, "Never found at Birr, nor by D'Arrest. Schönfeld has two observations, very faint, excessively small =13 *m* star, place agreeing with Herschel. Query: only a faint star."

The catalogue place was carefully examined (1891·747) without finding the least trace of any nebulous object. I found two faint nebulæ a short distance north, and compared them with the 8·2 *m* star, D.M. (32°) 281. The first is $1^m\ 21^s$ preceding, and 22″·4 south of that star; and the second is 58^s preceding, and 68″·4 north of the same star. These objects are respectively Dreyer 608 and 614. The differences applied to the D.M. place of the comparison star give for the nebulæ (1860):—

Dr. 608 R.A. $1^h\ 27^m\ 23^s$
Decl. $+32°\ 56'{\cdot}1$

Dr. 614 R.A. $1^h\ 27^m\ 46^s$
Decl. $+32°\ 57'{\cdot}6$

The Right Ascensions are each 7^s less than the catalogue places, while the declinations are substantially the same. On a

subsequent night this region was carefully gone over with the same result so far as No. 618 is concerned. There is certainly nothing in the catalogue place, and this object has probably been confounded with one of those mentioned above. This is also the case with No. 627. The place of this is a little following the two measured, and in about the same declination. The place of this was doubtful to Herschel, who says: "The R.A. conjectural, and P.D. liable to some error." It is safe to say that Nos. 618 and 627 do not exist, and that the observations credited to them really belong to Nos. 608 and 614.

No. 707.

R.A. $1^h\ 44^m\ 31^s$
Decl. $-9°\ 12'{\cdot}0$

This nebula was discovered by Tempel, and was described by him "very faint; faint star in centre." I looked this up (1891·766) more particularly to see whether it belonged to the planetary class, the possibility of that being suggested by the central star mentioned. It does not belong to that order of nebulæ. There are really two stars, one much fainter than the other, with a faint, diffused nebulous light surrounding them. I called the magnitudes 13·5 and 15·5. The latter would, of course, be entirely beyond the reach of the instrument used by Tempel. A rough setting of the wires gave for the angle between these stars 302°, and for the distance between them $10''{\cdot}4$.

The nebula was compared with a small star preceding, S.D. (9°) 345. This is $9{\cdot}8m$ in S.D. The nebula is 45^s following, and $26''{\cdot}8$ north. Applying these differences to the S.D. place of the star gives for the nebula (1860):

R.A. $1^h\ 44^m\ 31^s$
Decl. $-9°\ 12'{\cdot}8$

In identifying and fixing the place of this nebula I found a new one in the immediate vicinity, which was measured directly from the same comparison star used for the other.

S.D. (9°) 345, *and new nebula.*

1891·766 P = 260°·9 D = $221''{\cdot}3$

These measures give for the place of the new nebula (1860)

R.A. $1^h\ 43^m\ 31^s$
Decl. $-9°\ 13'{\cdot}4$

This is fainter than the other, though easily enough seen.

No. 736.

R.A. $1^h\ 48^m\ 35^s$
Decl. $+32°\ 21'{\cdot}1$

There is a cluster of faint nebulæ in this place. The catalogue places of the others are :—

No.	R.A. h m s	Decl. ° ′ ″	
737	1 48 36	32 21·6	Rosse
738	1 48 38	32 22·0	Rosse
739	1 48 47	32 28·0	Copeland
740	1 48 48	32 19·7	Rosse

No. 737 is described : "Stellar nebula (? faint star) 27″ north of *h* 169 (No. 736)." The 36-inch shows that this not a nebula, but a faint star, 13·5 *m*. Two measures of this from *h* 169 were made with the Parsonstown reflector. Evidently they are only very rough settings, as the difference in the distances is much too large for careful measures. These observations and my own are as follows :—

	°	″
1850·775	10·4	27
1874·022	11·9	35·1
1891·766	9·8	32·31

The 36-inch shows a very faint star, which I have called 15·5 magnitude, between and a little preceding the line joining the two objects measured above (Nos. 736 and 737). A single setting of the wires makes the new star 22″·0 from No. 736 in the direction of 7°·6. Of course a star of this magnitude is a faint object with the largest apertures. There is no trace of any nebulosity about either star. There is no doubt that No. 737 should be rejected as a nebula from any future general catalogue.

The position of No. 738 was also measured from *h* 169 at Parsonstown. This and the later measures are as follows :—

No. 736 *and No.* 738.

	°	″		
1850·775	43·7	75	Rosse	1*n*
1891·766	47·3	82·34	*β*	1*n*

Dreyer 740 is not far from a 9·4 *m* star, and I have measured the angle and distance directly, as was done at Parsonstown :—

D.M. (32°) 348 *and No.* 740.

	°	″		
1874·022	278·2	74·6	Rosse	1*n*
1891·766	279·3	74·11	*β*	1*n*

My measures applied to the D.M. place of the comparison star give for the place of the nebula (1860) :—

R.A. $1^h\ 48^m\ 48^s$
Decl. $+32°\ 18'·5$

There are some other faint nebulæ in the vicinity (Nos. 733, 750, 751, 760, and 761), but I did not examine these.

No. 874.

R.A. $2^h\ 9^m\ 43^s$
Decl. $-23°\ 50'{\cdot}5$

This was discovered by Müller with the 26-inch refractor of the McCormick Observatory. The description is, "Excessively faint, pretty small, extended 170° (? double star), 10 *m* star *n.p.*"

I could not find any nebula in or near this place. The vicinity was carefully swept over, without coming across any nebulous or suspicious object. The assigned place is well marked, as the nebula should be about 9′ south of an $8\frac{1}{2}$ *m* star (Gould 2301). This star, by the way, is double (new), 160° : 1″·2 : 8·7 . . . 10 estimated. It is safe to say that this nebula has no real existence. Probably a faint star was seen. The large telescope shows many near this place.

No 878 is south following the place of the other. I compared this with a neighbouring star (Gould 2284), which is $2^m\ 19^s{\cdot}5$ preceding, and 43″·6 south of the nebula. This gives for the nebula (1860):—

R.A. $2^h\ 11^m\ 30^s$
Decl. $-24°\ 1'{\cdot}9$

This was discovered by Leavenworth with the McCormick telescope. The R.A. from my observations is 40^s greater than that given in the General Catalogue. The declinations are nearly the same. This is a faint globular nebula, and comparatively easy.

No. 905.

R.A. $2^h\ 16^m\ 26^s$
Decl. $-9°\ 22'{\cdot}2$

This is also one of Leavenworth's discoveries with the McCormick 26-inch. In or very near the place I found what seemed to be an exceedingly faint patch of nebulous light. The seeing was not good enough to be certain that it was not due to faint stars, but it is probably a nebula. This is a very blank region for stars, and as there was no convenient comparison star, the place of the object was not taken.

No. 942.

R.A. $2^h\ 21^m\ 30^s$
Decl. $-11°\ 27'{\cdot}2$

No. 943 has exactly the same R.A., and is 1′·0 less in Decl., and given with the description, "Very faint, round; neb. double

star?" These were discovered by Müller at the McCormick Observatory. These objects should be very near a faint S.D.M. star, 9·4 *m.* The R.A. of that star is but 4^s more than that given for the nebulæ, and its Decl. $-11°\ 24'{\cdot}8$, and therefore the nebulæ should be about 1′ or 2′ south. There are two faint stars nearly in this place, but they have no nebulous appearance, and are certainly nothing but faint stars. A little following this place there is a small faint nebula (*a*), and still farther following a double nebula (*b c*). Both components of the latter have faint nuclei. The brightest of the two is *b*; and *a* is considerably fainter than either. I have compared these with the star mentioned above, S.D. (11°) 466, with the following result:

Neb. (*a*) *s* of star $187''{\cdot}5$ and 26^s *f*

Neb. (*b*) *s* of star $201''{\cdot}6$ and 49^s *f*

The double nebula was measured directly:

Neb. (*b*) *and Neb.* (*c*).

1891·769	P = 340°·3	D = 33″·90

These observations give the following places for these nebulæ for 1860:

	h m s	° ′
Neb. (*a*)	2 22 0·5	−11 27·9
Neb. (*b*)	2 22 23·5	−11 28·1
Neb. (*c*)	2 22 22·7	−11 27·6

There is but little doubt that the two nebulæ discovered by Müller are *b* and *c* of the foregoing observations. The other, *a*, is fainter, and might have been easily overlooked, and is certainly new.

There is a star $8\frac{1}{2}^m\ 13^s$ following, and 9′·4 north of the comparison star previously referred to, which is a new double star. As the components are quite unequal, it will not be readily seen with most instruments. This star is S.D. (11°) 467 (=Weisse II. 356=Santini 197). The star catalogues differ some in the declination. My measures of the companion are as follows:

1891·769	250°·9	4″·02	8·2 . . . 13

Two other nebulæ were found north preceding the double star; subsequently identified as Nos. 945 and 948 of Dreyer. The nearest was measured from the double star, and then the two nebulæ with reference to each other, with the following results:

Weisse II. 467 *and No.* 945.

1891·769	P = 334°·6	D = 277″·5

No. 945 *and No.* 948.

1891·769	P = 50°·6	D = 152″·4

Using the Weisse place of the comparison star, these observations give for the nebulæ (1860) the following:

	R.A. h m s	Decl. ° ′
No. 945	2 21 39	−11 11·7
No. 948	2 21 47	−11 10·1

In the General Catalogue there is a difference of 24^s in the right ascensions, and 1′·6 in the declinations. The first was discovered by Herschel I., and the other by Swift at the Warner Observatory.

No. 955.

R.A. $2^h\ 23^m\ 26^s$
Decl. $-1°\ 44'·0$

This nebula, which was discovered by Herschel I., has not been found at times by some observers, and variability has been suggested as an explanation. Dreyer has this note:—"In *Monthly Notices*, xxxviii.; 104, Winnecke drew attention to the remarkable circumstance that this nebula was invisible to Schönfeld in December 1861, and to Vogel in November 1865, while it was easily seen by D'Arrest, Schönfeld, and Winnecke in 1856, 1863, 1864, 1868, and 1867. Possibly the brightness of this object is variable. In November 1887 it was fully of the second class."

I found this (1891·747) in the proper place without difficulty. It is a long, narrow nebula, in a general way similar to Dreyer 607, which was examined a few minutes before. It has a bright central condensation, with nebulous wings on either side in the direction of 15°–195°. A setting of the wires gave for the extreme length 75″. On the whole it is rather a curious object, and should be easily found and seen. It is probable that the failures to find it, mentioned above, were due to unfavourable atmospheric conditions. This would fully explain the observations with the moderate apertures which were probably used.

No. 988.

R.A. $2^h\ 28^m\ 34^s$
Decl. $-9°\ 57'·9$

This was discovered by Stone at the McCormick Observatory, and is described in Dreyer as a "nebulous star 7·5 *m*." I could see (1891·766) nothing suggestive of any nebulosity about this star, or any peculiarity in its appearance. Other stars of about the same magnitude in the vicinity were looked at, and I could not detect any appearance in the star in question which was not common to the others. It was examined on the same occasion by Barnard, and he came to the same conclusion. It is

therefore safe to say that the suspected nebulosity about this star is a mistake.

No. 1059.

R.A. $2^h\ 34^m\ 45^s$
Decl. $+17°\ 24'{\cdot}5$

This is one of Herschel's nebulæ, "excessively faint, hardly sure." Dreyer says, "Not found by D'Arrest on a very clear night." I examined this region very carefully, and am satisfied that there is nothing in the catalogue place. About 1^m preceding this place, and $12'$ south I found a very faint nebula. This would be estimated as perhaps 14 magnitude. It is about $30''$ or $40''$ in diameter, with a gradual brightening towards the middle. It is impossible to say with certainty whether this is the Herschel object, but it is not improbable from the description. It is not otherwise in the General Catalogue.

This was compared with a 7·8 *m* star, D.M. (17°) 419 (=Weisse II. 820). The nebula is $183''{\cdot}9$ north of this star, and 37^s preceding, giving for its place (1860):

R.A. $2^h\ 33^m\ 37^s$
Decl. $+17°\ 12'{\cdot}7$

There is a small star near the catalogue place of Herschel's nebula, D.M. (17°) 422, which is a new double star. I did not measure it, but estimated, 160° : $1''$: 9·5 . . . 10·5.

No. 1186.

R.A. $2^h\ 56^m\ 20^s$
Decl. $+42°\ 16'{\cdot}5$

This was discovered by the first Herschel (=II. 502=*h*281). Dreyer has the following note:—"Twice looked for by Lord Rosse, but not found; often searched for in vain by D'Arrest. H. calls it 'a pretty bright star with two faint branches'; he has 'a star 14 *m*, with some kind of nebulous appendage.'"

This was readily found (1891·747) in the proper place. It is a 10 *m* star involved in a faint, elongated nebula. The conditions at this time were not very good, but the nebula appeared to be at least $2'$ or $3'$ in the longest direction. It precedes an 8·8 *m* star, D.M. (42°) 697, by 44^s, and is $274''$ south. From the D.M. place of the star we have for the nebula (1860):

R.A. $2^h\ 56^m\ 18^s$
Decl. $+42°\ 17'{\cdot}7$

No. 1363.

R.A. $3^h\ 28^m\ 6^s$
Decl. $-10°\ 18'{\cdot}8$

This nebula was found by me with the 18½-inch at Chicago in 1877. A companion nebula, No. 1364, was discovered subsequently by Müller with the McCormick 26-inch. The first was measured by me at the time of discovery from the 6½ *m* star, L 6634. The difference between the two distances is doubtless due to the fact that this is a large and generally round mass of diffused nebulosity without any central brightness for the accurate placing of the wires. The nebula as a whole is bright enough to be easily seen with the large star in the field. The measures are as follows:—

L 6634 and No. 1363.

1877·997	P = 62°·1	D = 206″·7
1891·845	60·8	203·4

No. 1363 and No. 1364.

1891·845	84°·0	136″·5

Swift IX. 13.

In *Monthly Notices* for December 1891 Dreyer has called attention to a nebula discovered by Swift (*Ast. Nach.* 3004) since the publication of the General Catalogue which may possibly be variable when all the observations, negative and positive, are considered. Swift was unable to find it again, and suggested that it might prove to be a comet. Herschel II. had recorded an object in this place, but it was rejected in his General Catalogue as being identical with a nebula a short distance preceding, discovered by Herschel I. It appears also to have been seen with the Rosse reflector at times, and invisible at other times. For details concerning these observations reference is made to the paper in *Monthly Notices* previously referred to.

I examined (January 28) the several nebulæ in this region, No. 1397 (=III, 569), No. 1417 (=II. 455=*h*306), No. 1418 (=II. 456=*h*307), and No. 1424 (Rosse), with the following result: All of these objects were readily found as given in Dreyer's Catalogue. Swift's nebula is in the place given by him, in line with Nos. 1417 and 1418. It is much fainter than No. 1418, the faintest of the Herschel nebulæ mentioned above, and has but half or two-thirds of the light of No. 1424. I compared it with the 8 *m* star north following (Lalande 6870). The nebula is 72ˢ preceding that star, and 223″ south. We have for the place of this object (1860) the following:

	h m s	° ′
h 305	3 34 32·5	−5 7 ±
Swift	3 34 37	−5 8·0
Burnham	3 34 34	−5 7·0

It follows, therefore, that Swift's nebula is really identical with the rejected *h*305.

There is no catalogue star near enough for direct measurement. There is a 12 *m* star nearly following, which I have measured from the nebula as follows:—

Neb. and star $P = 92°{\cdot}8$ $D = 155''{\cdot}0$

There is a fainter star much nearer the nebula in the direction of about 300°, and distance, perhaps, 20″ or 30″ With reference to the question of change, it can only be said that the evidence of change does not appear to be entitled to much weight, and the probabilities are that this object has been missed simply because the atmospheric conditions were not sufficiently favourable. The observer is much more liable to overlook differences of this kind when using the low powers ordinarily employed in work of this character. With powers of 400 or 500 and upwards used in making double-star measures, the difference in regard to illumination and definition on different nights is very apparent, and it is on only the very best nights that negative results have any value or significance. In double-star work it is almost a nightly occurrence with any telescope, large or small, that the instrument is pointed to stars which cannot be seen double on that occasion. In my experience this has happened thousands of times, but I have yet to find the first double star where these failures even suggested any variation in the light of either component. It would be very interesting to find a variable nebula, and this object should certainly be watched for a while to see whether there is any change in its light. Dreyer has pointed out that while this nebula was not seen on various occasions, it was only specially looked for in 1877 and 1890. It is easy to see how it might be overlooked under certain conditions, even with a pretty large instrument. In this connection I should say that the night on which my observations were made was much too poor to do any kind of double-star work, even on the easiest pairs, and therefore this nebula would appear fainter than it really is, but this would not affect the comparison with the other nebulæ in the vicinity.

Barnard.

R.A. $3^h\ 38^m\ 34^s$
Decl. $+34°\ 37'{\cdot}6$

This planetary nebula was discovered by Barnard with the 36-inch telescope of the Lick Observatory in December 1890, while examining the region near Zona's Comet (*Ast. Nach.* 3017). I have examined this on three different nights with the same instrument. It is a beautiful object, and has all the characteristics of the regular planetary nebulæ, with the single exception of the central star. On one occasion I suspected the existence of a faint star or nuclus, but could not be certain of it at that time or later. There are two small stars near it, as referred to in *Ast. Nach.* 3017. The nearest I have measured from

the nebula, and have also compared the latter with the 9 *m* star, D.M. (34°) 732.

Nebula and Companion Star.

1891·689	P = 288°·4	D = 21″·79	13*m*
·692	287·8	21·78 . . .	13*n*
1891·69	288·1	21·78	13

The other star, which is fainter, 14·5 *m*, is 33″ from the nebula in the direction of 347°.

Nebula and D.M. (34°) 732.

1891·689	P = 119°·6	D = 204″·5
·692	119·5	203·7
1891·69	119·5	204·1

The same comparison star was used by Barnard, who measured the difference of R.A. and Decl. directly. Reducing my angle and distance to the same terms, the results are :

1890·94	Diff. R.A. = 14ˢ·4	Dif. Decl. = 102″·0 B 1*n*
1891·69	14·4	100·7 *β* 2*n*

The nebula is slightly elliptical in a north and south direction. Measures of the diameter in the direction of 180°, using a power of 1000, gave the following :—

1891·671	10″·9
·689	9·1
1891·68	10·0

The place of this nebula for 1860, given above, is derived from the D.M. place of the comparison star and the measured differences.

No. 1458.

R.A. $3^h\ 40^m\ 40^s$ }
Decl. $-18°\ 40'·7$ }

This is from the Catalogue of nebulæ discovered by Leavenworth at the McCormick Observatory. The description in Dreyer is, "Very faint; very small; round; planetary? nebula?" This region was carefully swept over, and the only thing found was a bright, globular nebula about 2^m preceding the place given for No. 1458. I had overlooked this object in the General Catalogue, and was not aware that it was No. 1440,

and therefore fixed its position by comparing it with O. Arg. S. 2493. The nebula follows that star 29^s, and is $91''{\cdot}1$ north. This gives for the nebula (1860):

R.A. $3^h\ 38^m\ 43^s$
Decl. $-18°\ 42'{\cdot}6$

This is almost exactly identical with the place in Dreyer. It is hardly possible that I should have missed No. 1458 if any such object really existed. The other object may have been observed under conditions which made it appear much fainter than it really is.

No. 1555.

R.A. $4^h\ 13^m\ 48^s$
Decl. $+19°\ 11'{\cdot}2$

This is Hind's supposed variable nebula. I examined this very carefully in 1890 (*Monthly Notices R.A.S.*, December 1890), and was familiar with its appearance in the large refractor. It was again looked at several times in September and October 1891. At first it was thought to be a little brighter than in 1890, but subsequent examinations made this doubtful. It was also looked at with the 12-inch in 1890 and 1891, and there was no apparent change in the interval. Any variation would perhaps be more easily detected with this instrument than with the larger aperture. It remains to be seen whether there is any change after all in this object.

About 20′ north of this is the so-called variable, *U Tauri*. This is a double star, first noted as such by Knott. I have made the following measures:—

1891·772	203°·6	3″·25	9·3 . . . 9·4
·804	204·1	3·03	9·0 . . . 9·2
·810	203·7	3·08	9·0 . . . 9·1
1891·79	203·8	3·12	9·1 . . . 9·2

The only other measures with which I am acquainted are:

1868·01	202°·1	3′·10	9·9 . . . 9·9	Knott 2*n*

Of course very little, if any, change would be expected in a pair of this kind. The variability of this star does not seem to have been satisfactorily shown. On the whole, it is doubtful if there has been any change in the magnitude.

Nos. 1721, 1725, and 1728.

These three nebulæ, all in the same field, were discovered by Barnard in 1886, at Nashville, with a 6-inch refractor (*Sid.*

Mess., January 1886, and *A.N.* 2755). The places in Dreyer are as follows:—

	h m s	° ′
No. 1721	4 52 40	−11 20·6
No. 1725	4 52 55	−11 20·9
No. 1728	4 53 5	−11 20·6

They were subsequently discovered independently by Swift, and given in his *Third Catalogue*. The places in Dreyer are taken from this list. There are faint objects in the 36-inch. They are very much alike generally, but the preceding one is perhaps a little the brightest. The following one is extended in the direction of about 190°. All are considerably brighter in the middle. No. 1723 (Tempel), a short distance north of this group, is much like the others, but a little brighter. It is within a small triangle of stars, two of which are in the S.D. as 9 *m*, and the other is about 10 *m*.

I have measured the relative positions of Barnard's nebulæ (1891·845) as follows:—

1721 and 1725	P = 121°·4	D = 94″·1
1725 and 1728	61·6	78·3

From these measures, 1725 follows 1721 5ˢ·4, and is 49″·0 south; and 1728 follows 1725 4ˢ·7, and is 37″·2 north. The first of these I compared with an 8·4 *m* star preceding (L 9349). The nebula is 1ᵐ 52ˢ following, and 90″·0 north. Applying these differences to the position of the star, we have the following as the places of the nebulæ for 1860:—

	h m s	° ′
No. 1721	4 52 41	−11 19·9
No. 1725	4 52 46	−11 20·7
No. 1728	4 52 51	−11 20·1

No. 1788.

R.A. 4ʰ 59ᵐ 57ˢ
Decl. −3° 32′·7

This is one of the discoveries of the first Herschel (V 32). The description in Dreyer is "B, c L, R, b M***15.* 10, 1½′ 318°, inv. in the nebulosity." The large telescope shows that the brightest part of the nebulosity is around a star 11·5 *m* centrally placed, but it extends to the star referred to by Herschel. This star is S.D. (3°) 1013, where it is called 9·5 *m*. There is no star near the central star, and I do not know what is meant by the reference in the description given above. It would seem to refer to a triangle of 15 *m* stars within the nebula. I have measured the distance and angle of the 11·5 *m* star from the 9·5 *m*:

1891·845	P = 137°·4	D = 99″·07

Between these two there are two faint stars, forming a wide pair, perhaps 6″ or 8″ apart, about one-third of the distance from the 11·5 star towards the other. There is also another faint star a little following the middle of the line joining the same stars.

Barnard.

R.A. $5^h\ 14^m 33^s$
Decl. $+3°\ 20'·7$

This double nebula was discovered by Barnard in 1888 with the 12-inch telescope of the Lick Observatory. It is 55^s preceding, and 4′ south of the wide double star 23 *Orionis* (Σ 696). The two nebulæ with a $10\frac{1}{2}$ *m* star form a nearly equilateral triangle. Calling the nebulæ A and B in order of R.A., I have measured them with reference to each other, and also from the small star:

A and B.

1891·854	P = 115°·2	D = 36″·32
·893	114·5	36·03
1891·87	114·8	36·17

$10\frac{1}{2}$ *m Star and A.*

1891·854	246°·3	30″·42
·893	247·0	29·55
1891·87	246·6	29·98

$10\frac{1}{2}$ *m Star and B.*

1891·854	169°·8	25″·91
·893	169·5	24·83
1891·87	169·6	25·37

The preceding one of the two is the brightest, and is a little larger than the other. They are faint objects even in the large telescope, and without any well-defined nucleus. The place given above is for A, and obtained from measures by Barnard of its position with reference to D.M. (3°) 864.

In sweeping for these objects I found another nebula in the immediate vicinity which is new. This is similar in appearance to the others, but one or two magnitudes fainter. The position of this was measured from a 9 *m* star as follows:—

D.M. (3°) 863 *and Nebula.*

1891·854	P = 317°·7	D = 132″·8
·893	318·1	131·7
1891·87	317·9	132·2

Applying these measures to the place of the star as given in the *Albany Catalogue*, we have for the nebula (1860):

R.A. $5^h\ 14^m\ 40^s$
Decl. $+3°\ 10'·4$

No. 1931.

R.A. $5^h\ 22^m\ 9^s$
Decl. $+34°\ 8'$

This is one of the discoveries of Herschel I. It has been drawn by Herschel II. (*Phil. Trans.*, 1833) and by D'Arrest. Herschel, in his observations of nebulæ, describes it as "a nebula including a triple star forming an equilateral triangle; sides=4″; stars=11, 12, 14 *m*." The triple was entered as No. 367 of his *Second Catalogue of Double Stars* (*Memoirs R.A.S.*, III.) with the following note:—"One of the most curious objects in the heavens. It is a triple star forming an equilateral triangle, and placed exactly in the centre of a small circular nebula which extends a little beyond the stars." No measures were made, but the distance was estimated as 7″.

In 1876 I looked at this with the 6-inch and found the nebula faint with that aperture, but the three stars were easily seen. With the 18½-inch in 1878 I noted several other stars in the group, just outside of the nebula. The 36-inch telescope now shows that one of the stars of the triangle is double, having an exceedingly faint attendant at a distance of a little more than 2″. This is a difficult pair under ordinary conditions with this telescope, and probably could not be seen at all in any other telescope with which this object has been observed. In the following measures, A, B, and C are the stars which form Herschel's triangle:

A and B.

1891·753	234°·3	7′·88	9·5 . . . 10
·766	233·0	8·16	9·5 . . . 10
·785	234·1	7·97	9·5 . . . 9·7
1891·77	233·8	8·00	9·5 9·9

A and C.

1891·753	309°·9	10″·33	. . . 11·5
·766	311·4	10·62	. . . 10·5
·785	309·0	10·65	. . . 11·5
1891·77	310·1	10·53	. . . 11·2

B and D.

1891·766	327°·9	2″·40	. . . 15
·785	321·4	2·22	. . . 15·5
1891·77	324·6	2·31	15·2

There is a 14 *m* star about 6″·8 from A in the direction of 18°·7. Herschel estimated the angles of A B and A C as 220° and 280° respectively, and the distance of each 7″. The only other measures which I have found were made with the large reflectors at Parsonstown. Some of the distant stars were observed, but the close star was not seen. The measures of the stars in the triangle are :

1873·775	239°·2	7′·1	A B.
1873·775	310·5	9·7	A C.

No. 1988.

R.A. $5^h\ 29^m\ 4^s$
Decl. $+21°\ 7'·7$

This is Chacornac's so-called variable nebula near *ζ Tauri*. Dreyer states that Tempel pointed out many years ago that the supposed nebula was only the false image of the star. With the 36-inch there is not the least trace of any nebulosity in this place, and there is no doubt of the correctness of Tempel's explanation. Too much time has been wasted in looking for this object, and particularly since there was no reason whatever for believing in its existence after Chacornac himself failed to see it in 1862. Possibly some of the nebulæ may change, but the evidence of the actual disappearance of any object of this kind is very unsatisfactory, to say the least.

No. 2182.

R.A. $6^h\ 2^m\ 42^s$
Decl. $-6°\ 19'·0$

This is a large nebula surrounding a wide double star. The nebula is IV. 38 (= *h* 381). The double star is H 2298. It is much too wide to be of any interest as a double star. The description in *h* 381 is, " The large star of a double star has a

very strong nebulous burr." The double was estimated (Fifth Catalogue) 90° : 35″ : 8–9 . . 10.

The large telescope shows that the principal star is centrally placed in a faint nebula which is considerably extended in all directions. It is very much like the planetary nebulæ so far as the central star is concerned, but lacks the definite boundary which characterises all nebulæ of that class. The large telescope also shows, what is of more interest than anything heretofore seen in connection with this object, that this central star is a very close pair. It is much too difficult to have been discovered with the large reflectors with which the nebula has been observed. I have not looked at it with the 12-inch here; but under favourable conditions the elongation would probably be detected, but it could not be properly measured with such an aperture. My measures are as follows:—

A and B.

1891·854	122°·5	0″·52	8·7 . . .	9·0
·859	126·2	0·48	8·5 . . .	8·7
·903	124·7	0·45	8·5 . . .	8·6
1891·87	124·5	0·48	8·6	8 8

AB and C (= H 2298).

1891·854	92°·6	43″·87	. . .	10·5
·859	92·8	44·00	. . .	11
·903	93·4	43·74	. . .	10·5
1891·87	92·9	43·87		10·7

There are no other measures of C. The principal star (AB.) is S.D. (6°) 1431 (= Schj. 2066), and its position for 1860 is:

R.A. $6^h\ 3^m\ 41^s{\cdot}6$
Decl. $-6°\ 18'{\cdot}3$

This is the place of the nebula, and therefore there is an error of about 1^m in the catalogue R.A. given above. This star is 9·0 *m* in the S.D., and 9·3 in Schjellerup.

There are a number of other nebulæ in this vicinity which were also examined. No. 2167 is described as "a star 7 *m*, with a pretty strong nebulous atmosphere." I could not see any difference between this and other stars of similar magnitude in the neighbourhood. I have sometimes thought that all of the stars in this region of the heavens had a glow about them not

generally found elsewhere, but this may be only optical or imaginary.

No. 2170 is described as "a star 9 *m*, in a very faint, pretty large nebula, extended in 170°." The nebulous light around the small star S.D. (6°) 1414 is very marked, and must be at least 2′ or 3′ in diameter. It is extended nearly north and south, as described in the Catalogue.

No. 2183, discovered by D'Arrest, is very small, and has a minute but relatively bright central condensation, which may be a faint star.

No. 2185 closely follows the last, but is too large to be seen to any advantage with the lowest micrometer eye-piece, and its extent could not be properly estimated. The brightest part of it seems to be about a star 10–11 *m*.

No. 7114.

R.A. $21^h\ 36^m\ 13^s$
Decl. $+42°\ 12'{\cdot}3$

This is the well-known "Nova Cygni." In looking up this star I have relied entirely upon the admirable catalogue and accompanying map of the surrounding stars by Copeland and Lohse (*Copernicus*, *II.*, 101). The arrangement of the Catalogue is perfect in every respect, and the chart showing the relative positions of the stars could not be improved. Both should serve as models for all work of this kind. I may say, in addition, that it is remarkably complete in reference to faint stars. The large telescope shows very little more.

I estimated this star (1891·731) as about 13·5 *m*. The nearest star to the "Nova" given by Copeland, 314°·2 : 19″·1, is a little fainter, or about 14 *m*. The 36-inch shows nothing closer. At times the new star did not seem to have a perfectly stellar appearance under moderately high powers, but rather to resemble an exceedingly minute nebula. This appearance, however, may not be real. The star is too faint to allow one to decide a question of this kind with any certainty. I did not make any measures from surrounding stars, as that has been very thoroughly done by the authors of the paper referred to. They have the following notes concerning some of the faint stars:—

No. 20 (14·5 *m*) "Perhaps double."
No. 40 (14·5 *m*) "This star is probably double or multiple."
No. 82 (13·9) "Double?"
No. 88 (13·8) "Double?"

I have examined these stars with the following results:—

No. 20. While this is not double, strictly speaking, there is another star of nearly the same magnitude at a distance of 15″ or 20″, and that is probably what is referred to.

No. 40. There are two faint stars about 8″ or 10″ apart.
No. 82. I could not see any other star near this.
No. 88. This is a very faint pair of stars, with a distance of perhaps 2″ or 3″.

No. 7173.

R.A. $21^h\ 53^m\ 53^s$
Decl. $-32°\ 38'·1$

There are other nebulæ in this group (Nos. 7172, 7174, and 7176). They were accidentally picked up with the 12-inch, and, in consequence of a blunder in referring to Dreyer, they were supposed to be new, and therefore observed as given below. The comparison star is from the *Cordoba Catalogue*.

Gould 30117 *and No.* 7173.

1891·758	P = 30°·1	D = 361″·8

Gould 30117 *and No.* 7176.

1891·758	P = 44°·9	D = 350″·1

These measures give for the nebulæ (1860):

No. 7173	R.A. $21^h\ 53^m\ 53^s$, Decl. $-32°\ 38'·7$
No. 7176	R.A. $21^h\ 53^m\ 58^s$, Decl. $-32°\ 39'·8$

The last-named, No. 7176, is double in Herschel, the companion being No. 7174. With the 36-inch, with which it was subsequently examined, it appears to be one nebula, with a second very faint nucleus or condensation. I made the following measures with the large telescope (1891·766):—

No. 7173 and No. 7176	P = 130°·1	D = 89″·44
No. 7176 and No. 7174	238·2	25·62

No. 7172, which is about $5\frac{1}{2}'$ north of No. 7173, was not measured.

No. 7287.

R.A. $22^h\ 50^m\ 54^s$
Decl. $-22°\ 51'·1$

Discovered by Müller at the McCormick Observatory. It is described, "Excessively faint, slightly nebulous double star." I found two very faint objects about 20″ apart. It may possibly be a double nebula, but the following component seems to be a faint star only. The preceding one is undoubtedly a faint nebula. It is a little brighter in the middle, giving it a stellar appearance. Rough measures of the two give P=60°·5; D=20″·7.

No. 7403.

R.A. $22^h\ 45^m\ 57^s$
Decl. $+0°\ 44'{\cdot}3$

This was discovered by Coolidge at the Harvard Observatory. The description is, "Star slightly nebulous." A careful examination (1891·728) shows that there is certainly nothing of the kind in the assigned place. It should be about 7′ north of a 9 *m* star, D.M. (0°) 4935. In sweeping over this region I found a moderately bright nebula, which is probably the object in question. It is 38^s following, and $39''{\cdot}5$ north of the D.M. star mentioned above. This gives as the place of the nebula (1860):

R.A. $22^h\ 46^m\ 37^s{\cdot}1$
Decl. $+0°\ 38'{\cdot}2$

The nebula has a 10 *m* star $113''{\cdot}0$ distant in the direction of 230°·4.

About 15′ north of this, and a little preceding, there is a cluster of five faint nebulæ (Nos. 7396, 7397, 7398, 7401, and 7402), all but the first discovered with the Rosse reflector. These were readily found, and appeared to be in the catalogue places.

No. 7447.

R.A. $22^h\ 53^m\ 6^s$
Decl. $-11°\ 16'{\cdot}7$

Described in the Catalogue, "Star 11–12 *m* in neb." In the final notes it is stated that this was not found by Tempel on several occasions (*Ast. Nach.* 2284). I examined this region very thoroughly on October 29 without finding anything in the least suggestive of a nebula of any kind. In or very near the catalogue place there is a 11–12 *m* star, but there is nothing nebulous about it. A little *np* the place there is a faint triple star, A.B. 200° : 2″; A.C. 270° : 10″, and perhaps with a small aperture this group might be mistaken for a nebula. The place was carefully examined again on a subsequent night with similar results. This object certainly does not exist.

Nos. 7472, 7477, and 7482.

These three nebulæ are given in the General Catalogue as follows:—

	h m s	° ′	
No. 7472	22 56 34	+2 18	O. Struve
No. 7477	22 57 34	+2 21·9	D'Arrest
No. 7482	22 58 33	+2 19	Marth

It seemed a little strange that three separate objects should be distributed in this way, and a careful examination showed that all the observations related to one object. I went over the

whole vicinity on two nights, and I am certain that there is only one nebula here. That is $1^m\ 23^s$ preceding, and $30''{\cdot}4$ south of the 8·2 *m* star, D.M. (2°) 4609 (=Lalande 45206). Applying these differences to the place of the star from Schjellerup, we have for the nebula (1860) :

R.A. $23^h\ 58^m\ 31^s$
Decl. $+2°\ 17''{\cdot}2$

This agrees substantially with Marth's position, and his description is also correct.

No. 7693.

R.A. $23^h\ 25^m\ 59^s$
Decl. $-2°\ 3''{\cdot}9$

This was discovered by Hall in 1881, while observing Faye's Comet (*Ast. Nach.* 2394). It is described as a "Small nebula, or nebulous star." This was examined on two nights with the large telescope. It is a small faint nebula, a little brighter in the middle, but there is nothing stellar in its appearance. There is a small star near it with which it was compared :—

Neb. and 13m Star.

1891·675 P = 111°·2 D = 83″·72

For place it was compared with the nearest catalogue star, S.D. (2°) 5982 :—

Star and Neb.

1891·675 P = 112°·4 D = 277″·4

Applying these differences to Lamont's place of the S.D. star, gives for the nebula (1860) :—

R.A. $23^h\ 25^m\ 59^s$
Decl. $-2°\ 3''{\cdot}7$

No. 7804.

R.A. $23^h\ 54^m\ 9^s$
Decl. $+6°\ 58''{\cdot}1$

The description is, "Very faint double star, nebulous ?"; and in the final notes Dreyer says : "Found by Schweizer (*Observations de Moscou, II.*, 115), and observed by Bredechin in 1875. Described as F, E, a little brighter *sp.* Engelhardt in four observations could only see a double star without nebulosity."

I examined this region very carefully on two nights. The faint pair mentioned was found ; but there was no trace of nebulosity about it, or anywhere in the vicinity. I measured the double star as follows :—

1891·675 55°·6 9″·79 12·5 . . . 13

To find out whether this is in the place assigned to the supposed nebula, I measured it directly from the nearest catalogue star, D.M. (6°) 5233. This is a small star, 8·7 *m*. The prin-

cipal star of the faint pair is 160″·4 distant in the direction of 350°·0, giving for the place of the nebula (1860) :—

R.A. $23^h\ 54^m\ 7^s$
Decl. $+6°\ 58'·2$

This shows that it was certainly the object taken for a nebula by Schweizer, and observed by Bredechin. The comparison star used above is a wide double. A single setting of the wires gave 266°·1 : 15″·2. I ascertained later that it had been measured by Dunér in 1869. He found 265°·3 : 15″·26.

New Nebulæ.

In addition to the new nebulæ incidentally noted in the foregoing observations, I found the two given below. They are both in the field with a 9·5 *m* star, D.M. (40°) 608, and I have measured them directly from this star. The following nebula of the two is double. The nuclei are small, and fairly well defined. The other is only a little brighter in the centre, and considerably diffused. I have called the magnitudes of the nuclei of the double nebula each 14.

D.M. Star and Neb. I.

1891·673	P = 288°·8	D = 109″·72
·689	288·8	110·83
1891·68	288·8	110·27

D.M. Star and Neb. II.

1891·673	285°·5	169″·19
·689	285·6	169·34
1891·68	285·5	169·26

Neb II. (Nuclei).

1891·673	323°·1	17″·02
·689	321·7	18·06
1891·68	322·4	17·54

Applying these measures to the D.M. place of the star, we have for the nebulæ (1860) :—

	h m s	° ′
Neb. I.	2 40 49	+40 28′·5
Neb. II.	2 41 12	+40 28·6

The only catalogue nebula in the immediate vicinity is one discovered by Swift (No. 1086). This is larger than I., and brighter than either.

Mount Hamilton :
1892 *January* 30.

Ephemeris for Physical Observations

Greenwich Noon.	Angle of Position of ℒ's Axis. P	L−O.	Diff.	B	Annual Parallax. Δ−L.	Apparent Diameter. Equat.	Phase.	Polar.
1892.	°	°		°	°	″	″	″
May 21	335·634	239·669	403	+2·503	−8·438	34·76	0·19	32·53
23	335·684	240·072	398	2·520	8·658	34·90	·20	32·66
25	335·734	240·470	393	2·536	8·872	35·04	·21	32·79
27	335·785	240·863	386	2·553	9·081	35·19	·22	32·93
29	335·836	241·249	380	2·569	9·283	35·34	·23	33·07
31	335·887	241·629	374	+2·585	−9·480	35·49	0·24	33·22
June 2	335·939	242·003	367	2·601	9·670	35·65	·25	33·37
4	335·991	242·370	361	2·617	9·854	35·82	·26	33·52
6	336·042	242·731	354	2·633	10·032	35·99	·28	33·68
8	·093	243·085	347	2·648	10·202	36·16	·29	33·84
10	·144	243·432	340	+2·664	−10·366	36·34	0·30	34·01
12	·195	243·772	333	2·680	10·522	36·53	·31	34·18
14	·246	244·105	325	2·695	10·671	36·72	·32	34·36
16	·296	244·430	317	2·710	10·812	36·91	·33	34·54
18	·346	244·747	309	2·725	10·946	37·11	·34	34·72
20	·395	245·056	301	+2·740	−11·072	37·31	0·35	34·91
22	·444	245·357	292	2·755	11·189	37·51	·36	35·11
24	·492	245·649	283	2·770	11·297	37·73	·37	35·31
26	·538	245·932	274	2·785	11·397	37·94	·37	35·51
28	·584	246·206	265	2·800	11·488	38·16	·38	35·71
30	·629	246·471	255	+2·814	−11·569	38·38	0·39	35·92
July 2	·673	246·726	246	2·828	11·641	38·61	·40	36·13
4	·715	246·972	236	2·842	11·703	38·84	·40	36·35
6	·756	247·208	226	2·856	11·756	39·08	·41	36·57
8	·796	247·434	216	2·870	11·798	39·32	·42	36·80
10	·834	247·650	205	+2·883	−11·830	39·56	0·42	37·02
12	·871	247·855	195	2·896	11·851	39·81	·42	37·25
14	·906	248·050	183	2·909	11·862	40·06	·43	37·49
16	·940	248·233	172	2·922	11·862	40·31	·43	37·73
18	336·972	248·405	160	2·935	11·850	40·57	·43	37·97
20	337·001	248·565	149	+2·948	−11·827	40·83	0·43	38·21
22	·029	248·714	137	2·960	11·792	41·09	·43	38·45
24	·055	248·851	125	2·972	11·746	41·36	·43	38·70
26	·079	248·976	113	2·984	11·687	41·62	·43	38·95
28	·100	249·089	100	2·995	11·616	41·89	·43	39·21
30	337·119	249·189		+3·006	−11·533	42·07	0·43	39·46

of Jupiter, 1892. By. A. Marth.

Greenwich Noon.	Longitude of ♃'s Central Meridian ($877^{\circ}\cdot90$) I.	($870^{\circ}\cdot27$) II.	Corr. for Phase.	Light-time.	$\Lambda-O.$	B
1892.	°	°	°	m	°	°
May 21	340·93	334·58	+0·31	46·586	231·2345	+2·3953
23	296·44	274·82	·33	46·402	231·4180	2·4015
25	251·96	215·08	·34	46·213	231·6014	2·4076
27	207 48	155·35	·36	46·020	231·7849	2·4137
29	163·02	95·62	·38	45·823	231·9684	2·4197
31	118·56	35·90	+0·39	45·621	232·1519	+2·4257
June 2	74·11	336·19	·41	45·415	232·3354	2·4317
4	29·67	276·49	·42	45 205	232·5189	2·4377
6	345·24	216·80	·44	44·991	232·7024	2·4436
8	300·82	157·12	·45	44·774	232·8859	2·4496
10	256·41	97·44	+0·47	44·553	233·0694	+2·4555
12	212·00	37·78	·48	44·329	233·2529	2·4614
14	167·61	338·12	·50	44·102	233·4364	2·4673
16	123·23	278·48	·51	43·871	233·6199	2·4731
18	78·85	218·84	·52	43·638	233·8035	2·4789
20	34·49	159·21	+0·53	43·402	233 9870	+2·4846
22	350·13	99·60	·54	43·163	234·1705	2·4904
24	305·79	39·99	·55	42·922	234·3541	2·4961
26	261·45	340·39	·56	42·678	234·5377	2·5018
28	217·13	280·81	·57	42·433	234·7212	2·5075
30	172·81	221·23	+0·58	42·185	234·9048	+2·5132
July 2	128·51	161·67	·59	41·936	235·0884	2·5188
4	84·21	102·11	·60	41 686	235·2719	2·5244
6	39·93	42·57	·60	41·435	235·4555	2·5300
8	355·66	343·04	·61	41·182	235·6391	2·5355
10	311·40	283·51	+0·61	40 929	235·8227	+2·5410
12	267·15	224·00	·61	40 675	236·0063	2·5465
14	222·91	164·50	·61	40·421	236·1899	2·5520
16	178·68	105·01	·61	40·167	236 3735	2·5574
18	134·46	45·53	·61	39·913	236 5571	2·5628
20	90·26	346·07	+0·61	39·659	236·7407	+2·5682
22	46·06	286·61	·60	39·405	236·9243	2·5736
24	1·88	227·17	·60	39·153	237·1079	2·5790
26	317 71	167·73	·59	38·901	237 2915	2·5843
28	273·55	108·31	·59	38·651	237 4751	2·5896
30	229·40	48·90	+0·58	38·403	237·6587	+2·5948

The angle L − O + 180° is the jovicentric longitude of the Earth, reckoned in the assumed plane of *Jupiter's* equator from O, the point of the vernal equinox of *Jupiter's* northern hemisphere or the point of the descending node of the planet's equator on its orbit. B denotes the jovicentric latitude of the latitude of the Earth above *Jupiter's* equator. The annual parallax Λ—L is the difference between the jovicentric longitudes of the Sun and Earth. For the computation of the apparent diameters I have adopted the values deduced by Schur (*Astr. Nachr.*, vol. 129, p. 14) from his measurements made with the new Göttingen heliometer about the time of the last opposition. It were much to be desired that the several powerful heliometers now available should be employed about the time of the next opposition, while the phase is practically insensible, for measuring the equatorial and polar diameter of the planet, so that their united testimony might indicate the values, which are likely to come nearest to the true ones.

The two values of the "Longitude of 4's Central Meridian" given for each date are computed with the same rates of rotation as in the ephemerides for some preceding years; but as the motion of the great spot has again been slackening during the last season, I have restored in "System II." the zero-meridian to the place adopted in the Ephemeris for 1890, from which it was put back 10° in the Ephemeris for 1891, so that the longitudes of the spot computed from the data for the last apparition must be diminished 10°, in order to conform with the computed longitudes of 1890 and with those of the present Ephemeris. The "System I." of longitudes has been continued unaltered, as Mr. A. Stanley Williams' observations of a number of equatorial spots, which he has kindly communicated, render any alteration for the present undesirable.

The addition of the "correction for phase" to the longitudes of the central meridian gives the longitudes of the meridian which bisects the illuminated disc. The following is a list of Greenwich mean times, when the zero-meridian in the assumed two systems of longitudes will pass the middle of the illuminated disc :—

	I. (877°·90)	II. (870°·27)		I. (877°·90)	II. (870°·27)
1892.	h m	h m	1892.	h m	h m
May 21	10 21·4	10 37·3	24	7 15·5	8 7·7
	20 12·0	20 33·1		17 6·1	18 3·5
22	15 53·1	16 24·6	25	12 47·3	13 55·0
23	11 34·3	12 16·2		22 37·9	23 50·8
	15 36·0 ∓ occultation of		26	8 28·4	9 46·6
	*73 Piscium. *V.* note			18 19·0	19 42·3
	at end of list.		27	14 0·2	15 33·8
	21 24·9	22 12·0	28	9 41·4	11 25·4

1892.	I. (877°90) h m	II. (870°27) h m
	19 31·9	21 21·1
29	5 22·5	7 16·9
	15 33·1	17 12·6
30	10 54·3	13 4·2
	20 44·9	22 59·9
31	6 35·4	8 55·7
	16 26·0	18 51·4
June 1	12 7·2	14 43·0
2	7 48·3	10 34·5
	17 38·9	20 30·2
3	13 20·1	6 26·0
	23 10·6	16 21·7
4	9 1·2	12 13·2
	18 51·8	22 9·0
5	14 32·9	18 0·5
6	10 14·1	13 52·0
	20 4·6	23 47·7
7	5 55·2	9 43·5
	15 45·8	19 39·2
8	11 26·9	5 35·0
	21 17·5	15 30·7
9	7 8·0	11 22·2
	16 58·6	21 18·0
10	12 39·7	7 13·7
	22 30·3	17 9·5
11	8 20·9	13 0·9
	18 11·4	22 56·7
12	13 52·5	8 52·4
	23 43·1	18 48·2
13	9 33·7	14 39·6
	19 24·2	24 35·4
14	15 5·3	10 31·1
	24 55·9	20 26·9
15	10 46·5	6 22·6
	20 37·0	16 18·3
16	6 27·6	12 9·8
	16 18·1	22 5·5
17	11 59·2	8 1·3

1892.	I. (877°90) h m	II. (870°28) h m
	21 49·8	17 57·0
18	7 39·3	13 48·5
	17 30·9	23 44·2
19	13 12·0	9 39·9
	23 2·6	19 35·7
20	8 53·1	5 31·4
	18 43·7	15 27·1
21	14 24·8	11 18·6
	24 15·3	21 14·3
22	10 5·9	7 10·0
	19 56·4	17 5·8
23	5 46·9	12 57·2
	15 37·5	22 52·9
24	11 18·6	8 48·6
	21 9·1	18 44·4
25	6 59·7	14 35·8
	16 50·2	24 31·5
26	12 31·3	10 27·2
	22 21·8	20 23·0
June 27	8 12·4	6 18·7
	18 2·9	16 14·4
28	13 44·0	12 5·8
	23 34·5	22 1·5
29	9 25·0	7 57·2
	19 15·6	17 52·9
30	14 56·6	13 44·4
	24 47·2	23 40·1
July 1	10 37·7	9 35·8
	20 28·2	19 31·5
2	6 18·8	5 27·2
	16 9·3	15 22·9
3	11 50·4	11 14·3
	21 40·9	21 10·0
4	7 31·4	7 5·8
	17 21·9	17 1·5
5	13 3·0	12 52·9
	22 53·5	22 48·6
6	8 44·0	8 44·3

	I. (877°90)	II. (870°27)		I. (877°90)	II. (870°28)
1892.	h m	h m	1892	h m	h m
	18 34·6	18 40·0	19	11 40·4	4 30·7
7	14 15·6	14 31·4		21 30·9	14 26·4
8	0 6·1	0 27·1	20	7 21·4	10 17·7
	9 56·6	10 22·8		17 11·9	20 13·4
	19 47·2	20 18·5	21	12 52·9	6 9·1
9	5 37·7	6 14·2		22 43·4	16 4·8
	15 28·2	16 9·9	22	8 33·9	11 56·1
10	11 9·2	12 1·3		18 24·4	21 51·8
	20 59·8	11 56·9	23	4 14·9	7 47·5
11	6 50·3	7 52·6		14 5·4	17 43·1
	16 40·8	17 48·3	24	9 46·4	13 34·5
12	12 21·8	13 39·7		19 36·9	23 30·1
	22 12·3	23 35·4	25	5 27·4	9 25·8
13	8 2·8	9 31·1		15 17·9	19 21·5
	17 53·4	19 26·8	26	10 58·9	5 17·2
14	13 34·4	5 22·5		20 49·4	15 12·8
	23 24·9	15 18·2	27	6 39·9	11 4·2
15	9 15·4	11 9·5		16 30·3	20 59·8
	19 5·9	21 5·2	28	12 11·3	6 55·5
16	4 56·4	7 0·9		22 1·8	16 51·1
	14 46·9	16 56·6	29	7 52·3	12 42·5
17	10 27·9	12 48·0		17 42·8	22 38·1
	20 18·4	22 43·6	30	3 33·3	8 33·8
18	6 8·9	8 39·3		13 23·7	18 29·4
	15 59·4	18 35·0	31	9 4·7	4 25·1

(To be continued.)

Note on the Occultation of the Star 73 Piscium 6^{m}·4 by Jupiter on 1892 May 23. By A. Marth.

Assuming the apparent place of the star, as derived from the Greenwich Ten-Year Catalogue for 1880, to be α 0^{h} 59^{m} 16^{s}·29 δ +5° 4′ 36″·8, and referring it to the *Nautical Almanac* places of *Jupiter*, the rectangular co-ordinates of the star $x = s \sin (p - P)$ and $y = s \cos (p - P)$ referred to the axes of the disc of *Jupiter* and corrected for parallax will be

May 23. G.M.T.	$x = +0''\cdot651\ \rho_{,} +$	$y = +1''\cdot442\ \rho_{,} +$
h m		
14 0	$+49''\cdot23 - 1''\cdot448\ \rho' \cos (\lambda - 14^{\circ}\cdot96)$	$+12''\cdot33$ $+0''\cdot666\ \rho' \cos (\lambda - 1^{\circ}\cdot60)$
20	39·26 − 9·95	12·75 + 3·41
40	29·29 − 4·93	13·16 8·42
15 0	19·33 + 0·08	13·57 13·44
20	+ 9·36 5·09	13·98 18·45
40	− 0·60 − 1·448 $\rho' \cos (\lambda + 10^{\circ}\cdot10)$	+ 14·40 + 0·666 $\rho' \cos (\lambda + 23^{\circ}\cdot46)$
16 0	10·56 15·11	14·81 28·48
20	20·52 20·12	15·22 33·49
40	30·48 25·13	15·63 38·50
17 0	−40·44 30·14	16·04 43·52
20	$-50''\cdot39 - 1''\cdot448\ \rho' \cos (\lambda + 35^{\circ}\cdot15)$	$+16''\cdot45$ $+0''\cdot666\ \rho' \cos (\lambda + 48^{\circ}\cdot53)$

where λ denotes the longitude, east of Greenwich, of the place of observing, and $\rho_{,}$ and ρ' its distances from the plane of the equator and from the axis of the Earth.

The occultation of the star takes place so near the northern limb that any small error of the differences of declination will alter the times of the star's disappearance, and affects reappearance to such a degree as to render any prediction untrustworthy. Nevertheless, the knowledge of the times of the middle of the occultation and of its semiduration, though computed on the assumption of the correctness of the tabular values, may be of service, and these times are therefore given for a few observatories.

	Middle of Occultation. G.M.T.	Local M.T.	Semi-duration.
	h m	h m	m
Cape	15 34·7	16 42·6	∓18·5
Algiers	35·9	15 48·1	10·0
Madrid	36·0	15 21·1	9·5
Nice	36·3	16 5·5	9·4
Paris	36·5	15 45·8	8·8
Greenwich ...	36·6	15 36·6	8·6
Dublin	15 36·7	15 11·3	8·4